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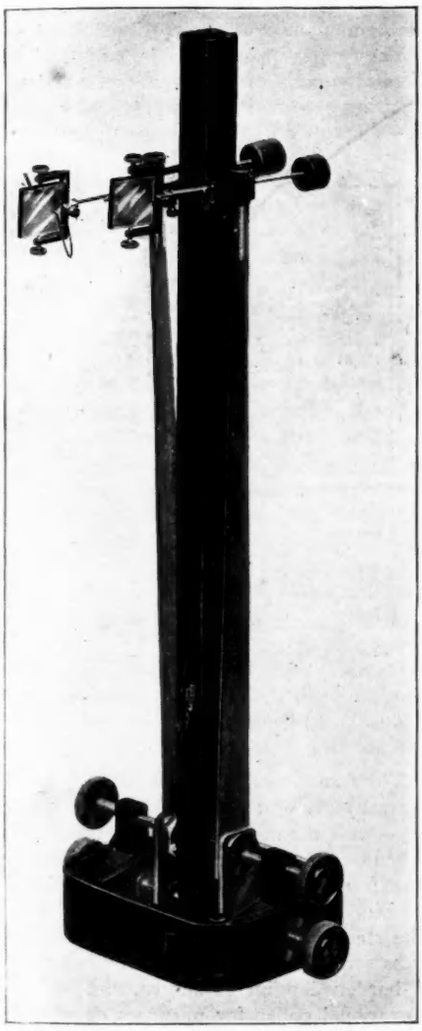
Mirror Apparatus for Testing.

BY GUS. C. HENNING.

In testing materials, more particularly those used in machine construction, accurate observations of elasticity and change of form are of the first importance, as the wear and tear of running gear depends mainly upon rigidity or permanence of shape. Heating of bearings is very frequently due to deformation of journal or boxes, rather than excessive pressures. Some materials give better results in running machinery than others; which might seem more appropriate on account of their greater strength.

Flexibility does not necessarily bear an inverse ratio to strength, and although a hardened spring bends more than most materials, for the same loads it actually bends less; but it will keep on bending, without injury, long after other materials have changed their shape permanently or have been broken.



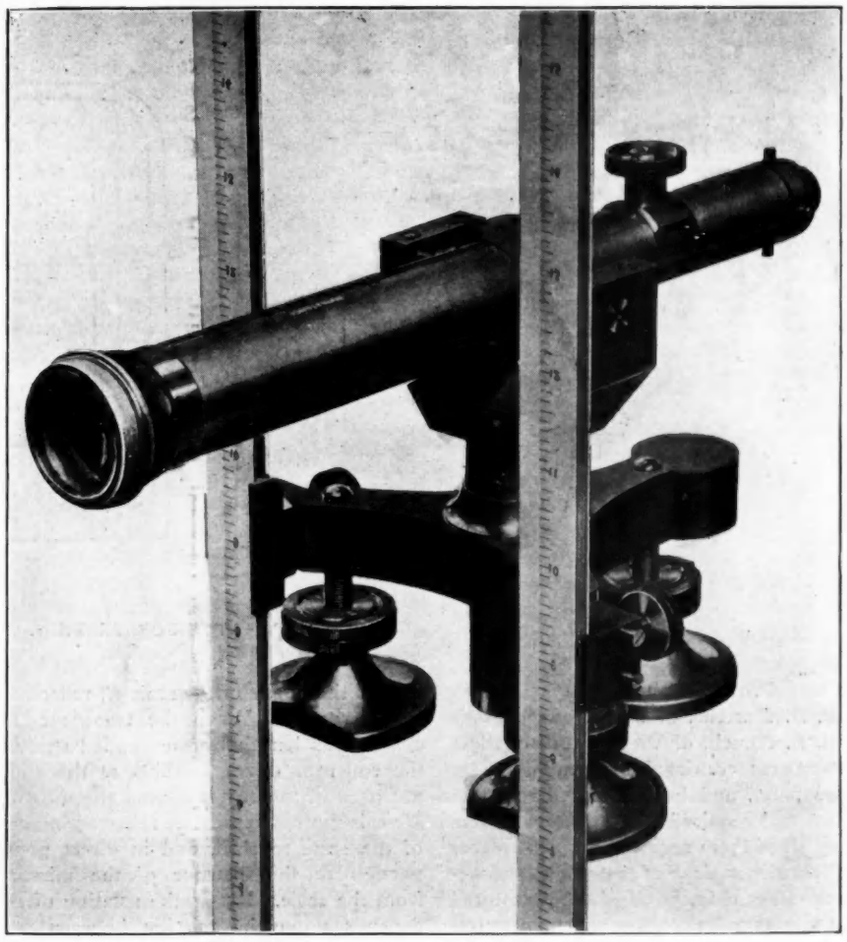


Fig. 2. MIRROR APPARATUS FOR MEASURING STRAIN IN TEST PIECES. Fig. 1.

In order to measure minute relative changes of shape, ordinary measuring devices are not sufficiently accurate. So small a quantity as $\frac{1}{10000}$ inch is for such investigations a large amount, because it is rarely possible to make measurements on long pieces of material, for lack of apparatus and facilities. The latter also become exceedingly costly and subject to error, or variations, on account of their weight and size. Hence, very delicate and necessarily very accurate instruments which are applicable to the ordinary standard lengths of test pieces of 8 or 10 inches, have become the rule.

Four types of instruments have been used for this work, viz.: (1) Comparators (cathetometers), (2) multiplying levers, (3) micrometer screws, and (4) mirror apparatus.

(1) The first are difficult to set up and use, very liable to accidental disturbance, and require absolute quiet; they have been almost entirely discarded.

(2) Multiplying levers have never been made of sufficient accuracy, and as they never measure axial, but only superficial changes of shape of one side of a piece, they are very unreliable and misleading.

(3) Various forms of single and double micrometer screws have been made and are in constant use, and give more or less accurate results, depending largely upon the operator using them. The one in most general use, and which has given the best results, is one designed by the writer in 1884.*

(4) The mirror apparatus was first designed and used in testing materials by the late Prof. J. Bauschinger;† then by Prof. A. Martens, of Berlin, and later by Prof. B. Kirsch, of Vienna. All of these instruments consisted of many separate loose parts, and hence were difficult to adjust and required much time to attach. They all of them required different pieces for increasing sizes of test piece, and became rather clumsy; all of them required that the gage length, on which measurements were to be made, should be accurately marked on opposite sides of the test pieces—a very difficult matter.

This led the writer to design a mirror apparatus which is free from the stated inconveniences and from inaccuracies.

*See Trans. Am. Soc. Mech. Engr's, Volume VI, page 479.

†See Bauschinger's "Mittheilwergen," Part IV.

Before proceeding to describe this design, it may be well to explain what a mirror apparatus really is:

It consists of a telescope by which the image of a scale reflected from a mirror, carried by a revolving prism or roller, is read. As used in testing materials, the mirror M (Figs. 3 and 4), carried by a roller or prism D, is held against the test piece T by the spring S, the lower end of which is fixed to the test piece at a certain distance from the prism or roller D. Opposite the mirror a scale R is mounted at a certain distance from it, and also a telescope O at any convenient point suitable to read the image of the scale R, reflected by mirror M. When the test-piece T changes its length by the applied stress, the roller or prism D shifts at the end touching it, thereby revolving the mirror M; this motion causes the reflected image of the scale to shift, and in direct proportion of the distance of the mirror from the scale. But as the rotation of D depends upon the relation between its diameter d to the actual change of length of T, and as the angles of incidence and reflection are equal, the actual change of length of T will be multiplied by

$$2 \times \frac{L}{d};$$

or, as two mirrors are used on opposite sides of the test-pieces, in order to obtain the true axial elongation, the correct reading will be

$$\frac{R + R_1}{2} = l;$$

hence, if R is divided into $\frac{1}{100}$ inches and $d = .24''$ and $L = 5'$ $(= \frac{6000}{100}'')$, then

$$l \times \frac{2 \times 6000}{24} = \frac{R + R_1}{2};$$

$$\text{or } \frac{l \times 4 \times 6000}{24} = R + R_1;$$

then the sum of the differences in readings reflected by the two mirrors will be equal to actual change of length of test-piece in hundred-thousandths of inches, a multiplication of one thousand times.

As it is always easy to determine d by actual measurement, and a scale of sufficient accuracy is easily obtainable, the instrument can be readily calibrated with little trouble.

The apparatus can, moreover, be used without a telescope, replacing the latter by a lamp, the ray of light from which is thrown by the revolving mirror on a scale mounted at any convenient distance.

The principal part of the apparatus consists essentially of a frame, Figs. 2 and 5, carrying a pair of springs, each of which has a revolving mirror at the upper end.

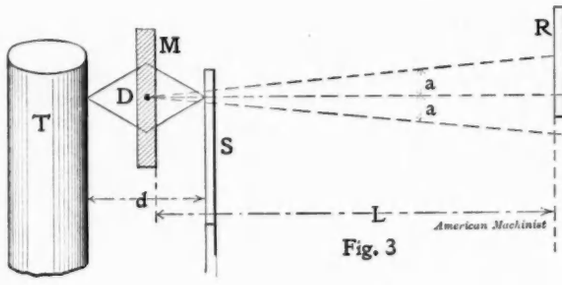


Fig. 3

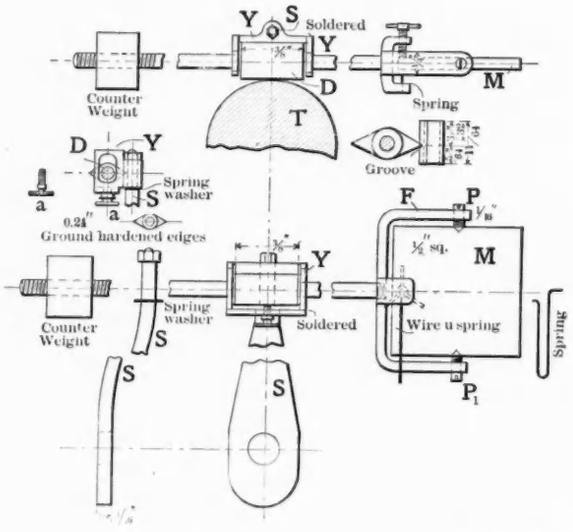


Fig. 4.

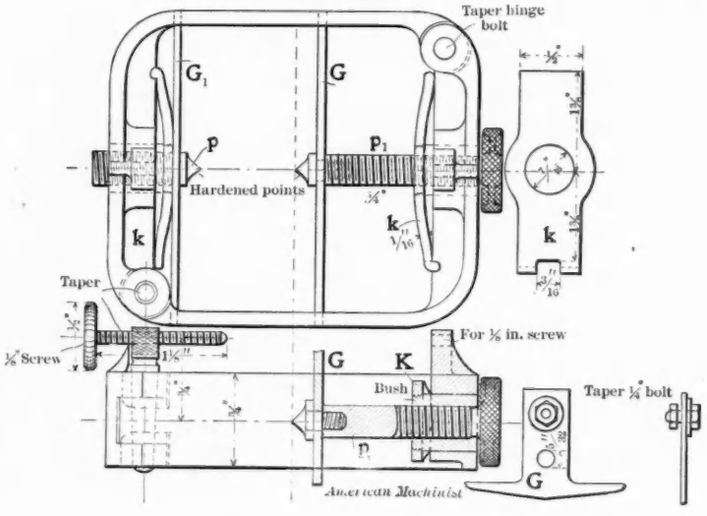


Fig. 5.

MIRROR APPARATUS FOR TESTING.

The frame, made of brass, is hinged on a steel taper bolt and is locked by a steel taper pin; the bottom surface of the frame when closed must form a plane. Through the frame pass two very nicely fitted cushioned bushes, which are screwed into the steel springs K; through the bushes pass screws p and p_1, each provided with a hardened point as shown, and with a hexagonal collar for purposes of adjustment.

The frame also carries two lugs as shown, which carry ⅛-inch screws with knurled heads. The bushes fit very perfectly, but slide freely, without looseness. The screws p and p_1 fit the bushes nicely, and the hardened points are exactly on the axis of the screws and ground if necessary.

The steel springs S are carried by the steady-piece or carrier G, and others of any desired length can be readily substituted for them. Through the lower hole passes the shoulder of the hardened points p and p_1, while the tapered bolt, with hexagonal head and nut, in upper hole, fits hole in lower end of S, so as to draw them together tightly; the hardened points must not pinch G when screwed home.

The upper end of S is turned down to a 1-16-inch diameter stud, with thread and nut, and carrying a small dished spring-washer; the nut must bear against a shoulder. This stud carries a yoke Y, of brass (shown in top and front view, and again in side view), without looseness or play, the spring-washer keeping it up against the nut when the latter bears against the shoulder. The yoke Y carries the knife-edge roller D loosely in clearance holes as shown, so that when the small screw a bears against its shoulder, D is carried, and one knife-edge bears in an accurate shallow groove cut in back of yoke Y, and the other stands at a definite distance (gage length) from the hardened point below it. This groove has a wider angle than that of the knife-edges. The knife-edge rollers must be hardened, and ground so that the knife-edges are truly parallel, and ought to measure over edges 0.24 inch; as it will be very difficult to make this distance strictly accurate in all cases, it is approximated closely, but parallelism of edges must be perfect, and actual distance across them is then measured and marked on each roller D. The spindles projecting from these rollers carry a mirror frame F at one end and a balance weight at the other. This frame F carries two fine centering screws P and P_1, which hold the ½-inch square mirror M. The frame F is also provided with a delicate adjusting screw R bearing against the edge of mirror, which is held against it by a fine wire U-spring T on opposite side, as shown. This frame and counterweight is of brass, while centering and adjusting screws are of steel. The centering screws are accurately opposite each other and concentric, and a plane through them passes through the axis of the knife-edge roller.

The other part of the apparatus is a properly arranged telescope with two scales adjustably mounted on its stand, so that they can be used in a horizontal or vertical position, and one can at the same time be set ahead of the other when necessary. Fig. 1 shows this arrangement.

The apparatus can be used in a vertical as well as a horizontal position, and is as serviceable for elongation as compression; for the latter purpose the yoke Y should be reversed or placed upside down, so that the spindles of D have more clearance in a downward direction.

Application: In order to measure the change of length of any bar, whether a part of a machine to be investigated, or a piece of material placed in a testing machine, the procedure is the following: After the hardened points p and p_1 have been advanced toward each other so as to be separated by a thickness equal to that of the bar, and the ⅛-inch steady screws have been advanced to bear against G, the taper pin closing the main frame is withdrawn, the frame opened and placed around the bar; the frame is then closed, taper pin inserted, and hardened points are brought to bear against the bar; the knife-edges D are then adjusted so that the mirror spindles stand parallel.

Now, the scales and telescope having been properly mounted and set, say 5 feet from mirrors, the latter are adjusted until the scales are reflected into the telescope. After slacking off the small screw a under the knife-edges D, the measurements can be proceeded with. The instrument is not again touched until the examination is complete, as all the observations are made by sight through the telescope, from a distance. This is a very important feature of the instrument, as the mere proximity of the body will, by expansion due to heat, introduce errors. In micrometer apparatus the most usual source of error is the disturbance of instrument by touch and heating due to proximity of operator, which cannot be avoided, and hence the results of different observers vary considerably; no allowance can be properly made. Very nervous or excitable persons cannot use such delicate micrometers at all, and for others considerable experience is necessary before they become expert in their use. A mirror apparatus, however, avoids such difficulties, and is readily adjusted, after a little experience with it.

New York.

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The Engineer's Lack of Business Efficiency.

"I have reasons of my own, born of a long acquaintance and daily contact with the individual, why the engineer has in so large a measure failed to hold his own in the business world, and I give them as follows: Because he is too often the slave to details. He is not always a student of human nature, and thereby fails to manage and understand men. He is too often deficient in business training, the keeping of accounts, etc., and, disclaiming all egotism he is withal a modest, diffident man, too much so for his own good. So many engineers in charge of work want to see and do everything themselves. They have a great horror of errors and mistakes and are willing to trust nobody. Their heads are full of measurements, weights, elevations, designs and all the ins and outs of the work in hand. They are a sort of monomaniac on the rules of construction, and for the time being live and exist upon their work and have no thought or care for anything else. Timid themselves, they teach it to their assistants. The pent-up Utica of their daily life is the limited area of their workshop. They are seldom in the cabinet and always in the field. The lawyer is always in the cabinet and seldom in the field.

"Now, a man should be commended for paying strict attention to business—it is almost the only rule of success—but should a man bury himself so deeply in its meshes that he is lost sight of? How would the battle go if the commanding general took a musket and lost himself in the ranks of his army? What would become of the ship if the admiral went below while engaged with the enemy? Victory in either case would be won by the subordinates in command. So it would be with the engineer in charge of work; let him divide the care of details with his subordinates; they will carry them out under the watchful, careful eye of the master, and he will thereby have more time to devote to the general management of the whole business. If the engineer is deeply absorbed in one set of details, he must, of course neglect others, and that is what he sometimes does; he will hold firmly to all the details of construction and neglect the accounts belonging to it, which are, in the eyes of nearly all men, the essential element of business. Some of our greatest engineers have been able business men. Captain James Eads was of this type, and so was the younger Roebling.

"The engineer of to-day should be a practical business man, and it is well if he acquire his business training, partially at least, by actual contact with business methods. He should be as well versed in business as the lawyer, the contractor and the makers and dealers in materials, as he is brought daily in contact with one or more of these persons.

"I have often noticed how great was the deference paid to the accounting officer of a corporation, either public or private, by its employés. Usually, a city clerk gives you to understand that he is the city, and the auditor of a railway company would make you believe that an inaccurate account sent to his office will have the immediate effect of derailing the limited express which runs over his road. Both are very exacting in their financial demands upon those who are accountable to them, sometimes arbitrarily so, but as a rule they are excellent business men—good models for the engineer to pattern from."—G. F. Goodhue. From Proceedings of the Purdue Society of Civil Engineering.

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The Commissioner of Navigation reports that American vessels built and documented during the first six months of the fiscal year number 384, of 113,572 tons, compared with 328, of 88,390 tons, for the first six months of the previous fiscal year, indicating the largest annual output within the last fourteen years except of 1890 and 1891.

De La Vergne Fly-Wheels.

BY H. L. ARNOLD.

The De La Vergne shops make three styles of fly-wheels—the smallest are solid, all in one piece; the next larger, up to 14 feet 6 inches diameter, are in two parts; and above that the wheels are made in four pieces, with eight arms, two arms cast solid, with each 90-degree segment of rim, and with bolted-on hub pieces. The two styles of pieced-up wheels are comparatively very low in labor cost, the two-piece 14 foot 6-inch wheel requiring only about 30 hours of labor in the machine shop, while a 20-foot wheel, weighing about 28,000 pounds, was built with about 110 hours of machine-shop work.

It may be well to note, in passing, that there are several valuable advantages connected with two-piece wheels of all kinds, whether pulleys, gears or fly-wheels, because the shaft which is finally to carry a two-piece wheel can be placed without the wheel; and no matter how firmly the wheel key must be driven, slackening the hub bolts will always make key removal easy, which is another very valuable feature. I remember seeing a steel mill of quite respectable size shut down for two whole days, because of a key that refused to come out of an 18-foot steel gear which had cracks in two arms and was unsafe; the repair gear lay on the floor ready to take the place of the old one, and for two days the key stayed in place, and the gear hub was finally drilled and split before the key let go. I am perfectly aware that a well-fitted key, driven in the solid, is the accepted thing for making a wheel and shaft turn together; but I have not the slightest doubt that a split hub is perfectly secure, and in every way the preferable form for work of all sizes, except perhaps the smallest; and I have heard more than one manager assert that all line shaft pulleys, of no matter what diameter, should be in halves.

The construction of the two-piece De La Vergne fly-wheel can be readily gathered by inspection of the working drawings of a 12-foot wheel, herewith reproduced in Fig. 1.

The halves are planed together by bolting both at once on the planer table, and planing the meeting faces simultaneously. Three flanged blocks are provided, of a hight suitable for going under the top half; the lower half is, of course, lined up on the planer table, and the top half on the blocks, and all staked and bolted in the usual manner. The De La Vergne big planer takes 121½ inches between the uprights, and has four tool boxes, two on the cross-rail, and one on each of the uprights; these last are used in planing the wheel-halves together. The hubs are faced 1-16 inch below the rim-ends, which gives room for ⅛-inch liner between the hub faces when the rim-ends are drawn up hard together with the links and keys.

The hub bolt holes are bored on the driller shown in Fig. 2. This driller is distinctly English in form, and is a very cheap and extremely useful tool, worthy of serious consideration, simple and "old-style" as it looks to be. The spindle is horizontal and has about 10 feet vertical adjustment on its pillar, a widely varying range of speeds, and is served by a carriage traveling on four wheels, rack and pinion adjusted, and capable of carrying 25 tons.

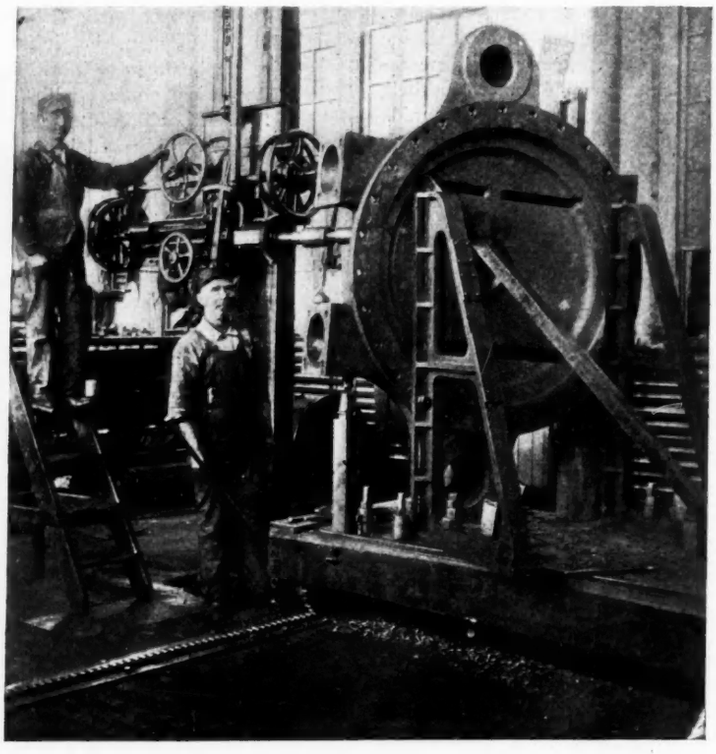

Fig. 2. HORIZONTAL DRILLER.

The four holes for the hub bolts are first drilled in one-half the wheel; then the two halves are set together in correct position on the floor, and the four holes in the second half are scribed from the first four and drilled to the marks, the head and nut seats being back-bored at each setting, so that the halves are then ready for bolting and keying together. The bolt holes are not reamed. The drawing shows the thin nut outside of the thick nut on the hub bolts. This is a drawing-room fancy; in the machine shop the thick nut is placed on the outside, as it should be.

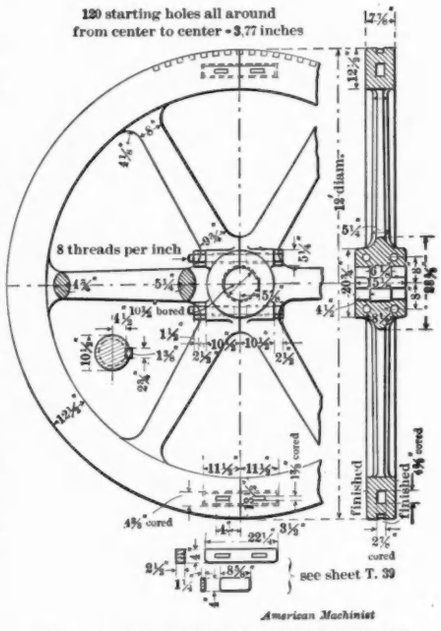

Fig. 1. TWO-PIECE, TWELVE-FOOT WHEEL.

The coupling links in the rim drop in rough-cored holes, and the link keyholes in the rim are also cored, and cored so carefully as to merely need smoothing a little with a file. The keys taper ⅛ inch to the foot and are driven hard home in oil, and are left long until after the hub is bored in the boring mill. Then the wheel is pulled apart, to permit the keyway to be cut on the slotting machine, which completes the job ready for shipment, if the rim is to be left rough. If the rim is to be finished, the wheel is again keyed and bolted, the key-ends are cut off and the wheel is put on a centering stud on the boring mill face plate, and has a cut taken over key-ends and all. Where the size of the wheel is such as to make it more convenient to transport it in halves, so that the rim-link keys have to be driven out, there is said to be no trouble in again driving the keys to place, so as to make a smooth job when the wheel is finally home on its shaft.

All wheels put together with this form

of rim-fastening must have one-half lifted at least half the link length higher than its final position, to put the wheel together on its shaft, and this is the only feature due to this form of wheel construction which is in the slightest degree inconvenient, while for simplicity and low labor cost this form of wheel is noteworthy. When the wheel is finally in place the hub liners are omitted. This gives the hub bolts the possibility of closing the hubs hard on the shaft and key. The bolts are cut 8 p. i., which gives them a good strong pull, and with check nuts makes hub-fastening sufficiently secure, while at the same time permitting the easy and quick removal of the wheel.

It would seem as if the rim links needed a side fit, but such is not the case, as the loose link is so firmly held by the keys as to answer every purpose.

I was informed that a 14-foot wheel of this pattern had been put up with only 20 hours' labor charged against it, and that the usual time was well under 30 hours.

The full construction of the four-section, eight-arm large wheels is given in Fig. 3, from the De La Vergne blueprint of the Allegheny 12,000,000-gallon pumping engine. This particular wheel is 20 feet in diameter; weight about 28,000 or 29,000 pounds.

In fitting, the quadrants are first pieced up into pairs by planing the meeting faces and keying in the rim links, which go slack in rough-cored holes, same as in the smaller sizes of wheels. This brings the wheel into halves, which are then planed on their meeting faces, and at the same setting the hub flats are planed, care being taken, of course, to have the hub faces of the arms uniformly the same distance below one face of the rim, so that one rim face of the sections will match up. The hub ends of the arms are then made all the same thickness. As the big planer takes 10 feet between the uprights with 1½ inches to spare, it is just roomy enough to finish the segments for a 20-foot wheel.

The two halves of the hub are made in the boring mill, with recess and projection as shown to keep them fair with each other; first one-half is made with a centering projection in the middle as shown; then the other half is made and fitted to the first part, and finally both halves are bolted together on the boring mill without moving the last half finished, and a rough boring cut, about ⅛ inch under size, is taken through the entire hub, which is made short, so that when finally bolted in place on the arms the two halves of the hub will be open a little way in the middle, as shown in the drawings.

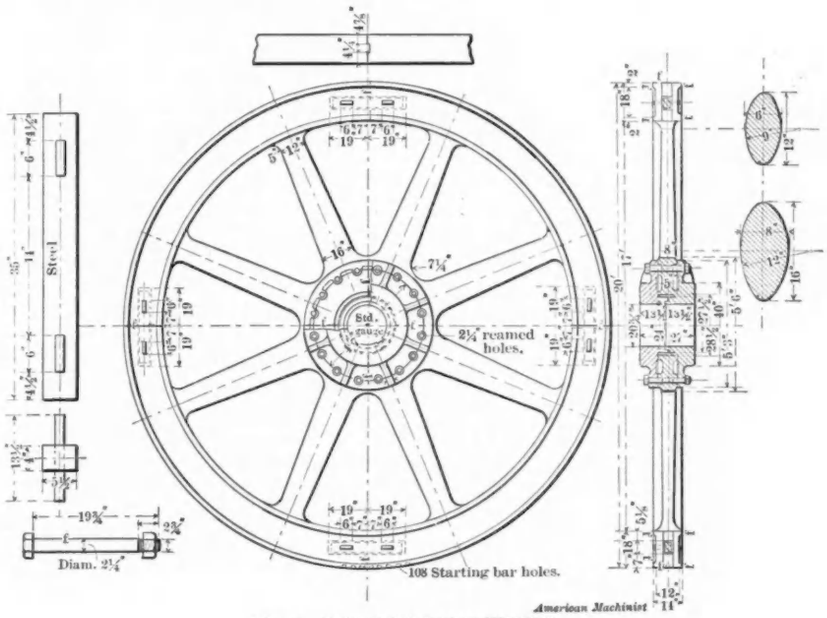

Fig. 3. TWENTY-FOOT WHEEL.

The hub-halves are applied to the arm-ends as follows: First all the hub-bolt holes are bored in one hub-half; then the two halves of the hub are put in place on the arm-ends and carefully set so the bore is true with the rim by measurement, the half which has the bolt holes bored in it being placed uppermost; then one bolt hole is drilled through the arms and the lower half of the hub, reamed, and the bolt driven home and screwed up hard. Then the other holes are bored and reamed, each one being filled with its bolt before the next hole is drilled.

This wheel is shown on the floor in process of having its hub fitted on, in Fig. 4, and Fig. 5 shows the wheel in the boring mill. There is a special flanged stud bolted and doweled to the boring-mill face plate, projecting upward the full length of the hub bore, and turned to fit the rough boring of the hub as first made. This stud is flanged on the inside at its bottom end, so as to leave it all one diameter outside. After the wheel has the hub bolted on, it is set on this stud and blocked up and bolted down while the rim is turned, the stud centering the wheel accurately. After the rim is turned, the stud is taken out of the hub, which is then finish-bored to size.

As will be seen by the drawings, the rim is not finished all over the sides, so that the rim-link keys come through in

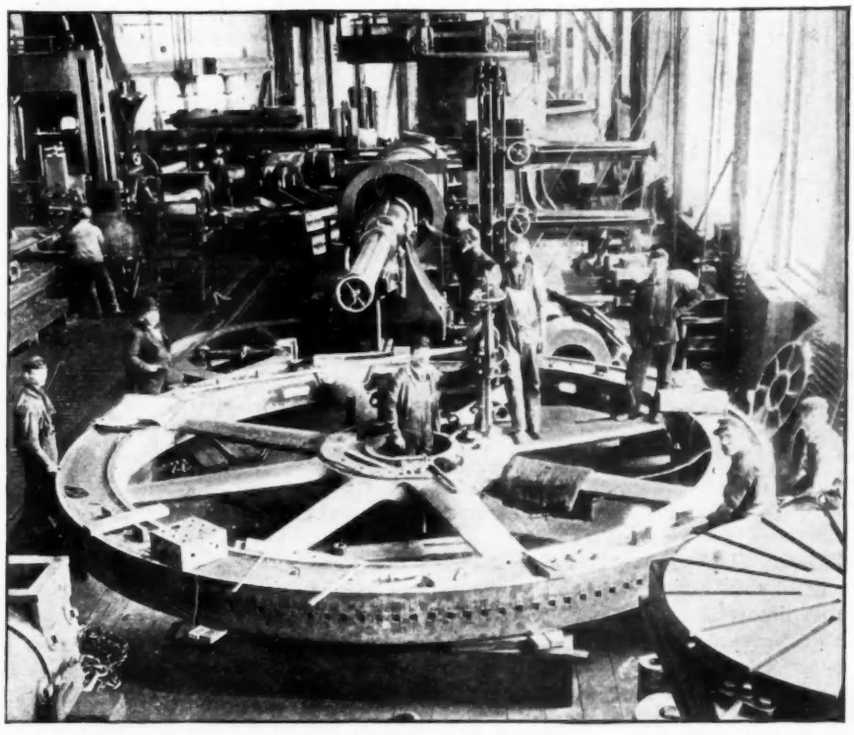

Fig. 4. TWENTY-FOOT WHEEL—FITTING HUB TO ARMS.

a rough surface. This enables the hard-driven rim-link keys to be left long while the rim-finishing is in progress. After the wheel is in place where it is to run, the keys are driven hard and cut off flush on both sides.

I have thus minutely detailed the construction steps of these wheels because they are cheap and good, and the low labor cost required to produce them makes the manner in which they are built a matter of interest.

There are places, perhaps not quite so well equipped as the De La Vergne shops, which are paying for a great deal more time on wheels of these sizes; and though part of this labor expenditure may be charged to want of the best facilities, more of it is due to the original design, which calls for more machine work than is needful.

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Cost of an Armor-Plate Plant.

An interesting report has been made to the Committee on Naval Affairs by Secretary Herbert, in which is given the cost of the construction of the armor-plate department, at Homestead, Pa., of the Homestead Steel Works, as shown by an official examination of the books of the Carnegie Steel Company.

The cost of reconstruction of the 32-inch armor mill is given as $78,414.33; the cost of the machine shop is placed at $676,614.94; that of the press shop at $1,357,294, and of the tempering, annealing and Harveyizing shop, $259,743.25, or a total cost for the armor-plate department of $2,372,066.79. The amount expended in the erection of the foundry was $34,982.99; for the armor bolt and nut shop, $6,341.19, and for the changes at open-hearth furnaces, at Plant No. 2, for the casting and handling of large armor ingots, including that of a large casting pit, that sum is given as $153,253.48. In addition to the foregoing, the amount of $9,375.32 was expended for a water line from the reservoir to the armor-plate department, making the total cost $2,576,019.77.

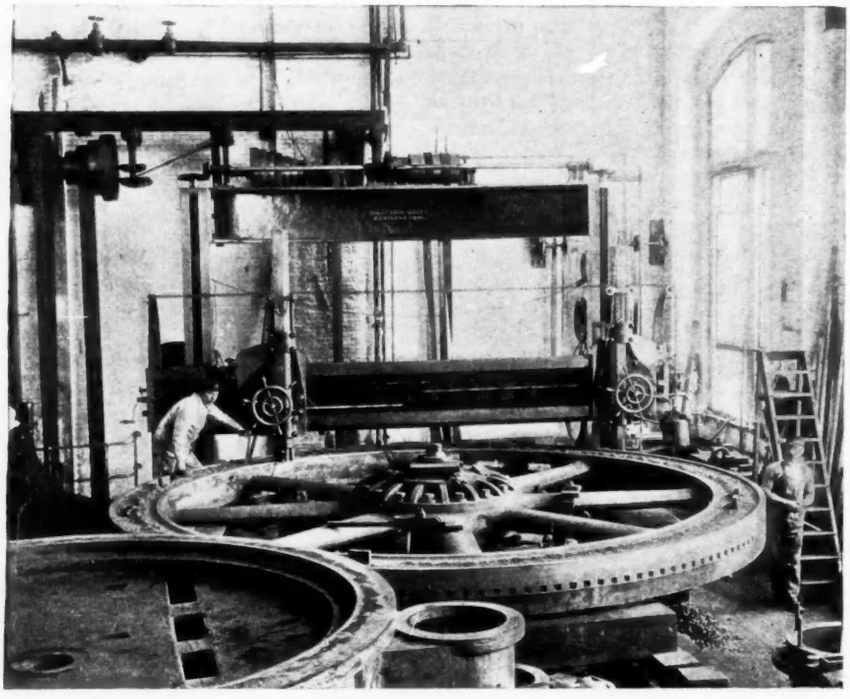

Fig. 5. WHEEL IN THE BORING MILL—FINISHING.

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Packing Machinery for Export.

Some time ago one of our readers who is connected with a machine-building establishment suggested that the subject of proper packing of machinery for export would be a good one to discuss in our columns. Thinking the suggestion a good one, we acted upon it, and asked several whom we supposed ought to know a good deal about the matter, for the results of their experience, and we print below a letter received from Chas. Churchill & Co., of London, practically all of whose merchandise consists of tools and machinery shipped from this country, and from a great number of different manufacturers, using different methods of packing. Messrs. Churchill have, of course, had exceptional opportunity to study the matter, and to observe results, good and bad, of the different plans followed. Their letter may therefore be considered as expert advice on the matter. It is as follows:

Editor American Machinist:

We have yours of the 8th January, respecting proper mode of packing machinery for export, and we have much pleasure in giving you our views in regard to this business. We regret to say it is one in which many of our American manufacturers need a great deal of education, for they do not seem to realize that goods crossing the Atlantic are placed at nearly every conceivable angle, and are continually being rolled about the ship; and frequently when cases are opened here, the machines or tools are found broken inside the cases. This does not refer to all our makers, for a goodly number of them have realized what is necessary; and we are pleased to say that, as a rule, they are now using more care for the safe arrival of the goods on this side.

Referring to the use of large boxes or small ones; medium-sized cases are always better for handling, both in loading and unloading from steamers, railways, etc.; and cases weighing from 100 to 1,000 pounds are more satisfactory for shipping than larger cases. Of course, on heavy machinery this limit is not possible; but we do recommend our makers, as far as possible, on heavy machinery, to take off such parts as can be removed and pack in separate cases. This reduces the weight of the main case. Some of the steamship companies are unwilling to take cases weighing more than 2 or 3 tons, for the reason that they have no facilities for placing these heavy cases in the hold of the ship, and special derricks have to be brought alongside to place them on board; this is avoided when the machines can be reduced in weight, to not exceed 3,000 pounds.

We would next point out that every machine should be thoroughly stayed with wood braces inside the case, these braces resting against such solid portions of the machinery that they will cause no damage, and no fragile part of the machine should be allowed to come within 1 inch of the packing, as any slight motion of the machine in the case causes these lighter parts to be broken. Machines should be stayed in every direction, so that, even if the cases are turned completely over, no harm can come to the machine. Again, all the machines must be thoroughly coated with some composition that will keep moisture from the bright parts. A composition of vaseline or petroleum, we find more satisfactory than paint and white lead, especially in coming these short distances.

Packing cases are not needed to be waterproof, as the machinery is packed away from the water, and our opinion is that crates with slight openings, on heavy machinery and tools, are more satisfactory than tight boxes, as the parties handling them are thus able to see what they are handling.

It is not necessary to match-line any cases for machinery coming to Great Britain, unless the tools are very high-class indeed; such as the finest watch machinery.

CHARLES CHURCHILL & Co. Ltd.,
Charles Churchill,
Managing Director.

London, Eng.

Molding Hawse Pipes at the Bath Iron Works Foundry.

The pattern from which the mold is made consists of a round pipe, split lengthwise. In order to allow for waste in cutting bevels, the pipe is made two or three feet longer than the required length of the casting. The outer edge of the hole which is cut in the vessel's bow, to receive the pipe when cast, is in the form of an ellipse. The pattern must be inserted in this hole so that the split parts will be at the points of the long diameter of the ellipse. By means of a scratch awl the pattern is first marked around on the outside, close to the side of the vessel. A second mark is then made around the pattern on the inside of the vessel.

The pattern is now sent to the pattern shop and sawed off at the first mark, and a heavy half round flange is nailed on. A red chalk mark is made over the second mark, for the molder to stop or cut off the right shape and length.

Now the molder takes one half of the pattern, lays it on the mold board, puts the cope on over the pattern, sets a sprue in the side for the gate, and a riser on the top of the lip or flange, and then proceeds to ram up the cope. A bottom board is then bedded and nailed or dogged on.

The cope is now turned over by means of a crane attached to the trunnions on its sides, Fig. 1, *A*. The flask has holes in each end to correspond to the size of the pattern. The pattern having been made longer than necessary, it projects from one end of the flask. A parting is made at the flange end of the pattern, from the center of the flange to the hole in the end of the flask, as shown in Fig. 1, *B*. The half pattern is drawn out of the sand and fastened to its other half by means of dogs.

If the pattern is a long one, a hole is dug in the floor, and the pattern is stood in the hole with its flange end up.

It is necessary to use an arbor in this style of work. It consists of a stock of wood long enough to extend through the flask, round or hexagonal in shape, and 3 or 3½ inches smaller than the inside diameter of the pattern. Rows of nails to hold the sand are driven firmly into the arbor, but left projecting from it about 1½ inches. (See Fig. 2.) The arbor is clay-washed before putting it into the pattern, and ¼-inch rods are laid against it for vents, Fig. 3, *C*.

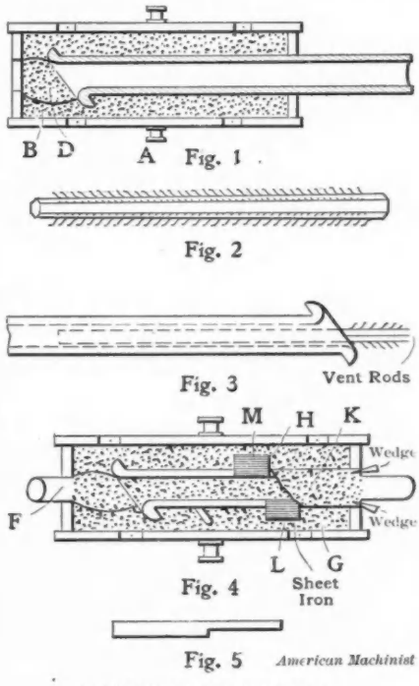
The sand, which has already been prepared, is now rammed into the pattern with a long stick, small enough in diameter to go in between the nails on the arbor. Even and continuous ramming is necessary until the pattern is full.

Before the pattern is returned to the mold, wet parting-sand is put on that part of the joint which will come underneath the arbor, Fig. 1, *D*. Without separating the pattern, it is returned to the mold from which it was taken.

We next ram up around the end of the arbor and form a joint from the center of the half-round flange to the hole in the end of the flask, Fig. 4, *E*. Parting-sand is put on; it is then ready for the other part of the flask (which is similar to the cope already used), and is now put on over the pattern and rammed up.

After a thorough venting, a bottom-board is bedded on and nailed or dogged. A screw is inserted through a hole in the board, extending into the pattern firmly enough to lift that half of the pattern when the flask is separated.

Before separating the flask, the vent-rods that were rammed up in the core are drawn out, and nails placed in these vent-holes to prevent them from being



MOLDING HAWSE PIPES.

filled with sand while working on the mold, Fig. 4, *F*.

The upper part of the flask is now removed and turned over. The screw is removed, the pattern is drawn from the sand and placed on the core. Marks are made on the joint, at the points where the red chalk-marks on the pattern come in contact with the sand, No. 4, *G* and *H*. The pattern is removed, and a mark is made across the core from *G* to *H*. The core is built up with sand from this mark to the end of the flask, Fig. 4, *K*.

The strike (Fig. 5) which is cut out the thickness of the pattern, is now used to strike off the sand (Fig. 4, *K*) to the proper thickness. The cores are set in the side of the flange. The flask is closed and clamped; the arbor is wedged, and all being secure, the flask is turned over.

Before lifting the cope, the pattern is secured by a screw, the same as mentioned in the other half.

After the cope is taken off and turned over, the process is the same as in the other half. Before stopping off this half of the pipe, two pieces of sheet iron are placed at *L* and *M* (Fig. 4) to keep loose sand from dropping down under the core. The cores are set in this half of the flange. The gate is cut as in any ordinary mold. The sheet iron is removed, and necessary finishing is done.

After the flask is closed and clamped, the arbor is firmly wedged, care being taken not to jar it. The nails are removed from the vents and the board from the top. The mold is now ready to pour.

GEORGE W. DEAN,
Foreman of Foundry.

Bath, Me.

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The Gas Exhibition.

The Gas Exhibition which glowed at Madison Square Garden, in this city, for ten days, under the auspices of the Gas Industries Company, deserves passing mention, although it possessed little direct mechanical interest or novelty. The vast auditorium was brilliantly and beautifully illuminated without the pungent ray of the arc light. Gas-making processes, apparatus and appliances were well represented. The most prominent feature of the entire display was probably in the line of stoves and appliances for heating and cooking. Here, by the way, the foundryman shows the highest achievements of his art, and, as he has few opportunities, with little aid from or co-operation with other handicraft. The display of gas engines was smaller than might have been expected, although those shown were good. An anomalous feature was the presence of several steam engines driving pressure blowers or exhausters, the latter being on exhibition, while the former were not supposed to be. Some pipe-cutting machinery and one or two special appliances constituted the entire mechanical feature of the exhibition.

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An exhibition of motors and machine tools will be held in Munich from June 1 to October 10, 1898, to which the manufacturers of all countries are invited to send exhibits. This exhibition is held under the auspices of the General Industrial Association of Munich, and those desiring further information will obtain it by corresponding with the association above referred to, whose offices are at Farbergraben, 1½, Munich, Germany.

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Heat expands and cold contracts most substances. Cable road slots seem to be subject to the same law. In the severest cold of this winter, in Chicago, the contraction of the cable road slots caused serious delay and inconvenience. The contraction is probably to be accounted for by the more rapid decrease of temperature inside the conduit than in the earth outside.

Repairs of Electrical Machinery—III.

BY A. R. HARRIS.

Ring Armatures.

In a previous article upon this subject, attention was called to the fact that it is very important to make the proper connections between the commutator and the armature coils, as much so as the connections between the ends of the coils themselves. In what follows will be shown what the effect of false connections is.

It is only when the coils are wound one on top of the other that there is any danger of making a mistake; but, fortunately, it is very seldom that smooth-core armatures are wound in this way, and with the grooved type it is always possible to see where the ends come from; hence, if the order in which the armature coils should connect with the commutator is understood, there should be no difficulty in connecting them in the proper order.

To illustrate the matter, consider the diagrams shown in Figs. 1 and 2: The former represents a grooved armature with three coils in each groove, and these are wound so that the ends issuing from the outside surface of the armature, and which we will hereafter call the inside ends, do not all come out on the same side of the groove; thus the end of coil No. 1 comes out from the left-hand side, and so does that of coil No. 3, but the end of coil No. 2 issues from the right side. In Fig. 2 three coils are also shown, but the inside ends of all come from the left-hand side of the groove. An examination of Fig. 1 will show that the connections between the armature coils and the commutator are apparently crossed, the wires leading to segments 2 and 3, serving to cause this impression; but if we trace out the connections, we will find that they are correct; hence, what at first glance would seem proper, is in reality wrong, and it is this deceptive appearance that frequently leads to mistakes. Starting with the wire that connects with commutator section 1, we will find that it leads from the inside end of coil 1, and that the outside end of this same coil, which comes from the inside surface of the armature, connects with the inside end of coil 2, this end coming from the right side of the groove. The outside end of coil 2, which comes from the left side of the groove, connects with the inside end of coil 3, which also comes from the left side of the groove. By tracing the connections further, we will find that the outside end of coil 3, which comes out on the right side of the groove, connects with the inside end of coil 4, which is at the bottom of the second groove, and the inside end of which issues from the left side of the second groove. By following the connections further, it will be found that in each groove the order in which the ends connect with each other, and with the commutator, is the same as in the first groove, and all are correct.

In the connections shown in Fig. 2 there is not so much danger of making a mistake, as all the inside ends of the coils come from the same side of the groove; hence the wire from No. 1 coil leads to No. 1 commutator segment, and the wires from coils 2 and 3 connect with the commutator segments in regular order, and there is nothing to tend to confuse the eye. That the connections in Fig. 1 are correct, can be more readily seen from Fig. 3, which is a simple diagram in which both ends of the wire are shown in the squares that represent the coils, so as to remove the mistiness surrounding Fig. 1. Fig. 4 is a similar simplified diagram of the connections shown in Fig. 2. A comparison of these two figures will show that the difference between the connections with the commutator, that appear to exist in Figs. 1 and 2, is due wholly to the fact that in the first the order in which the coils are wound is not uniform; the bottom coil and the top one starting from the left-hand side, and the middle one from the right. In Figs. 3 and 4 the wires leading to the second and third commutator segments run down the right side of the groove, and the only difference between the connection of these wires with the armature coils is that in Fig. 3 the end of coil 1 is directly under the beginning of coil 2; and hence, two short lines lead to the line that runs to commutator segment 2. In Fig. 4 the beginning of coil 2 is not over the end of coil 1; therefore the lines are not of the same length, that running to the beginning of coil 2 being long enough to pass to the other side of the square that represents the coil. On paper, this line can be run across the diagram to connect with the wire leading to the commutator segment. But in the actual machine, the connection cannot be made so easily; the wire must pass over the outside of the coil and thus give rise to the confusion shown in Fig. 1.

As a misconnection of the armature coils with the commutator segments will cause the machine to run in an abnormal manner, which may be more or less serious, according to the magnitude of the error in the connection, and as such false connections can be detected by the behavior of the machine, it is advantageous to know what changes from the normal action are produced by the mistakes that are most likely to be made. This can be illustrated quite clearly by the aid of Figs. 5 and 6. In Fig. 5 the armature coils are shown on an incline, so as to more readily show the misconnections. To be properly connected, the coils 1, 2, 3 of the armature *A* should connect with segments 1, 2, 3 of the commutator *C;* but if, in Fig. 1, the wires were run so as to not cross each other, the connections would be from coil 1 to segment 2, from coil 2 to segment 3, from coil 3 to segment 1. Thus we see that the actual connections would be as in Fig. 6, and coils 1 and 2 would be connected one segment ahead of their proper position, while coil 3 would be two segments back of where it should be. Now consider the commutator segments to be in motion, so as to pass under the brushes through which the current enters the armature; then when the brush rests on segment 1, the current will pass to coil 3, and as the second segment comes into position, the current will shift its point of entry from coil 3 to coil 1, thus stepping back two coils. When segment 3 passes under the brush, the point of entry of the

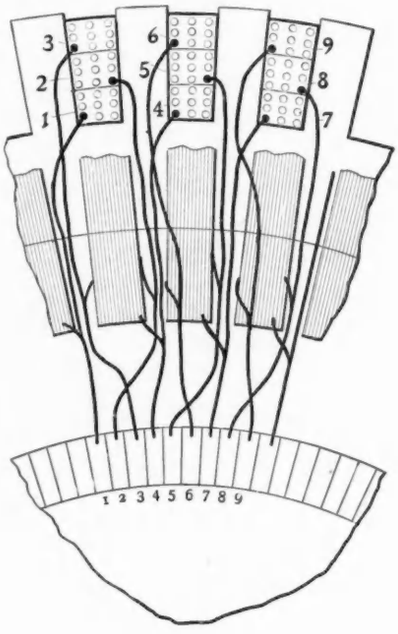

Fig. 1

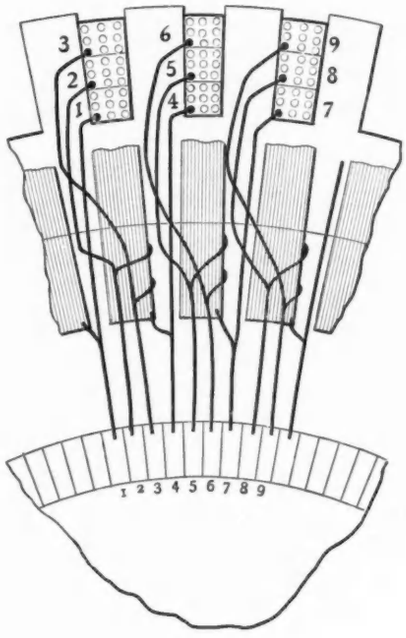

Fig. 2

THE CONNECTION OF GROOVED ARMATURES.

current will advance one coil, as it should; but as segment 4 runs under the brush, the current will advance to coil 6 and temporarily short-circuit three coils, namely, 3, 4 and 5. The effect of this action will be that the brushes will spark badly, and upon examination it will be found that the sparking takes place between the segments that are connected with the coils ahead of their place and those adjoining them; that is, between 4 and 3, and between 4 and 5, and also between 7 and 6, and 7 and 8. If all the coils are improperly connected, the sparking will take place on the 1, 4, 7, 10, 13, etc., segments, all the way around the commutator, and the indications of sparking will be about the same at all these points; but if only a few coils are wrongly connected, the segments which they involve will show the effect very plainly, and all the others only to a slight extent. It is not very likely that a new armature and commutator would be connected improperly, and as it is not very often that an old one is wholly disconnected, it is probable that in the great majority of cases only a few connections would be wrong, and when such is the case, their location can be ascertained by the appearance of the commutator segments, as those directly connected with the coils improperly connected would show the greatest damage from the sparking.

The velocity of the machine will also indicate whether the connections are proper or not, as the effect of any defect will be to make the armature rotate faster if the machine is a motor of the constant potential type, and slower if it is of the constant-current type; if a dynamo, it will run easier and generate less current or lower E. M. F. If the velocity of the machine when in proper order is known, it can easily be ascertained whether there has been any change in speed; and if there has, this, in connection with the evidence of sparking between the commutator segments that are separated from each other by regular intervals, will serve to show conclusively that the connections are wrong.

There are many other ways in which false connections may be made; but with the type of winding here considered, those discussed are the most common, and the easiest to detect, as they invariably leave their marks behind in the shape of charred insulation between the commutator segments.

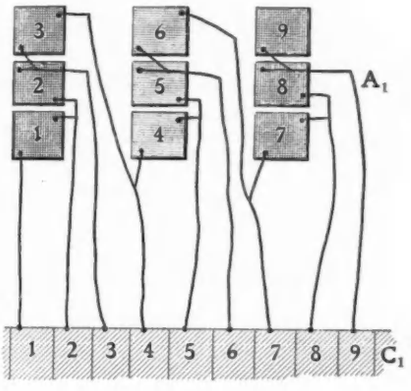

Fig. 3

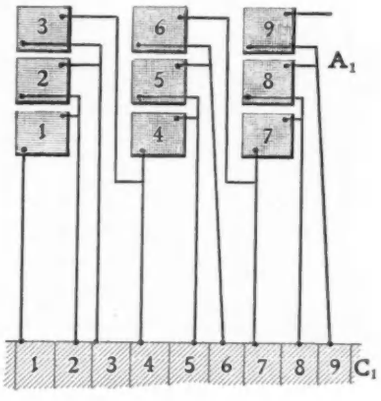

Fig. 4

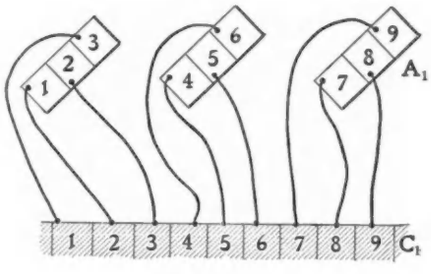

Fig. 5

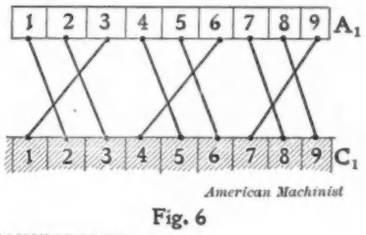

Fig. 6

RIGHT AND WRONG CONNECTIONS.

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We have an account of some experiments made with a compound engine in Alsace, to determine the economy of superheating. The mean steam pressure used was about 70 pounds, gage. The engine was first tried with saturated steam, and then, successively, with steam superheated 76, 151 and 180 degrees Fahr., showing savings, respectively, of 10.5, 14.3 and 19.3 per cent. in feed water, and 8, 14.4 and 20 per cent. in coal. With saturated steam the consumption was 16.5 pounds per I. H. P. per hour, and with 180 degrees of superheating the consumption was 13.2 pounds.

Strength of Hoisting Drums.

BY CHARLES LEWIS.

Hoisting drums are subjected to strain through the medium of chain or cable under tension, winding on and off the drum surface as the load rises and falls. Three separable and distinct strains are thus imposed—a direct crushing, a simple bending and a simple torsion.

For direct crushing the case can be readily analyzed by supposing the drum to be cut at any longitudinal section through its axis, and the two halves held together by the cable wrapped about them. If we could exert a force from the inside of the drum, tending to push these halves apart, this force would be balanced by a corresponding tension in the cable. Conversely, if we put tension in the cable, we press the surfaces at the joint together with a corresponding force. If tension in the cable were equal in all the coils, the pressure per square inch at the joint would be equal for the full length of the drum. But the tension in the cable cannot be equal in all the coils, under the circumstances of the case, for it gradually decreases on account of friction on the drum surface. The tension for a single coil, however, can be considered uniform throughout its length without serious error. As we are seeking a maximum value, take the first coil, or the one from which the cable passes directly to the load:

Let T = tension in cable in pounds;
t = thickness of drum in inches;
p = pitch of cable on drum in inches;
f_{dc} = fiber stress for direct crushing.

Then $2T = 2ptf_{dc}$.

The first member of the equation is the force with which we are pressing the two halves of the drum together, considering length of drum under one coil only. The second member of the equation is the area of surface pressed multiplied by fibre stress per square inch, which gives the crushing resistance of the section. Solving this equation gives:

$$t = \frac{T}{pf_{dc}} \text{ or } f_{dc} = \frac{T}{pt}$$

These values assume a uniform distribution of pressure, and that the area under one coil takes all the strain from that coil. Neither assumption is exactly correct, but, for a rational method, gives close approximation and safe results.

The bending strain is due to load T acting at the point where cable leaves drum and passes to the load. This gives maximum bending moment, for a drum between bearings, when the cable has wound to the center of the drum; for an overhung drum, when the cable has wound to the farthest point from the bearing:

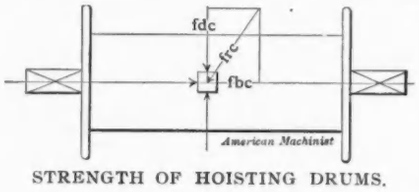
Let M_b = maximum bending moment due to concentrated load T;
D = outside diameter of drum, or for grooved drums diameter to bottom of groove;
d = inside diameter of drum;
f_{bc} = fiber stress for crushing due to bending.

$$\text{Then } M_b = .0982 \frac{D^4 - d^4}{D} f_{bc}$$

$$\text{or } f_{bc} = \frac{M_b D}{.0982 (D^4 - d^4)}$$

The fiber stress due to torsion is readily found by equating the torsional moment to the moment of resistance for torsion for a hollow circle, found in any handbook. It always figures so low for the usual drum proportions that it is purposely not included in the combination of stresses which follows, for the sake of simplicity.

Returning now to the direct-crushing strain first found, it is to be noted that it occurs equally at all points around the ring; hence, to find the maximum combined stress, we must take the point at which maximum bending stress occurs. Consider the accompanying sketch: The vertical arrows represent direct crushing due to wrapping of the cable about the



STRENGTH OF HOISTING DRUMS.

drum. The horizontal arrows represent crushing due to bending. The final resultant stress is evidently the diagonal, or

$$f_{rc} = \sqrt{f_{dc}^2 + f_{bc}^2}$$

The text-books offer us no analysis of the strains in hoisting drums. The above rational method has been used by the writer for a great number of chain drums, and for a smaller number of drums using wire rope. The weights of the drums have been reasonable, and in several hundred cases no failures or cracking have occurred under heavy loads, showing that the calculated thickness has been right for expenditure of material, and certainly on the safe side for strength. It should be noted that the combining of the stresses, in many cases, changes the result but little. For wire rope drums of large diameter and close pitch, the direct crushing decides the thickness at once. For chain drums where the diameter runs small, and distance between bearings is long, the bending cuts more of a figure. Again, if the drum is deeply grooved, the diameter to bottom of groove is all that is available in using factor D when figuring for bending; while for direct crushing the whole sectional area may be figured in. This will often make the direct crushing and the crushing due to bending about equal, the resultant stress being equally dependent on both.

A final word of caution may be added with respect to practical foundry considerations. The strength of a drum exposing itself to strain successively at all points, is the strength of its weakest point. Hence, oval cores, bulging cores, cores which sag, and cores which for other reasons are not what they were intended to be, may furnish weak points which will endanger safety. Again, turning off more metal on one side than the other in the machine shop to avoid bad spots, may develop unforeseen weakness. The only way to know "where we are at" is to drill a series of small holes, and actually measure the thickness. This is seldom done, and, in fact, should not be necessary. The only way to avoid difficulty is to work the metal to a low fiber stress in the calculation, and insist upon careful pattern-making and molding. Here is an opportunity for some of our expert foundry friends to start a discussion on the best methods of molding and casting drums of various thicknesses and lengths.

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For Industrial Museums.

The extract which we give below, from "Machinery," London, is only a sample of much similar suggestion now current in our foreign, and especially our British exchanges, and it is commended to the attention of our readers. It is certainly time that we as a Nation, and as individual States, were not only moving, but doing something substantial in the direction indicated. Libraries and art galleries, all accessible to all the people, are of the highest value to the community, and the noble work of their establishment goes constantly forward with the highest approval of all. But, side by side with these, a most desirable and admirable thing would be the means, as here suggested, of showing to our workers and thinkers, in tangible and enduring form, what has been done, what is being done, and how it is being done in the various departments of human activity. It would seem to be an anomalous state of affairs that an industrial and inventive nation, still looking to its inventions and its industries to give it supremacy, should have no systematic or organized means of diffusing the knowledge most necessary to a healthy industrial life. We extract from our contemporary's article as follows:

"Side by side with the palatial buildings erected for imparting the scientific and technical education which, in the Fatherland, is considered essential to the proper equipment of the youth of the 'World Empire,' stands, even more ornate and attractive and costlier, the Gallery of Illustration, where all the newest inventions in the arts and crafts which mark a nation's industrial progress are exhibited gratis. The Germans long ago appreciated the great fact that one illustration is worth a hundred specifications, and that the untrained eye takes in with lightning rapidity the lessons which lectures and books will not convey, except at the cost of months of laborious study. So in all the great commercial centers the Museum of Inventions, whether recording the latest discoveries in chemistry, a field in which Germany is far ahead of all Continental States, or the newest developments of machinery, is the latest contribution of the State, or it may be the municipality, to the labor competition in the markets of the world. Nor is any sum grudged by the different legislatures to render the exhibition complete up to date, and attractive alike to workman and employer, to the student, the scientist, and the general public. We cited, a few weeks ago, the old city of Nuremburg as offering an example of the mode in which the German cities have taken up this profitable branch of education, and we showed how Stuttgart and other capitals have followed in her track. More recently the great training city of Hamburg has voted a grant for this purpose which would seem extravagant to any urban or district council in this country, and even the Swiss Republic has commenced operations of the same kind on a hardly less imposing scale, although it has no colonies across the sea to provide for, and no fierce rivalry with wealthy and jealous neighbors. Turn where we will, in fact, illustration is the leading feature of the new wave of progress, and the nation will regret its tardiness in this direction if it neglects the teachings with which the necessities and the experience of its competitors have led them to endow the rising generation."

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The Locked-up Steel Formula.

In our issue of January 14th, we mentioned a novel and mysterious process for making "Damascus" steel, and of the locking-up of the formula in a safe deposit vault, the conviction for murder of the inventor, Dawson, and the consequent embarrassment of the company organized to work the process, through their inability to obtain a practical knowledge of it. Dawson has now assigned his rights to his wife; but that does not seem to help the company, as they are as yet unable to secure the mutual consent necessary to a sight of the precious document. An interesting lawsuit over the matter is now in prospect. So far as we know, no steel maker has yet shown much anxiety to get at the secret of the safe deposit vault.

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Mr. H. A. Lozier, the bicycle manufacturer, says: When the season (1896) opened, 210 firms in the United States were competing with each other in the trade, of which 135 failed or went out of the business during the year, leaving the field open to 75. These firms turned out 900,000 bicycles.

Helical and Spiral Chips—Easy Rolling Chips.

BY TECUMSEH SWIFT.

There are very few mechanics, if indeed there are any, who do not know the difference between a cylinder and a sphere; and yet it is a rather peculiar fact that, judging by the way they talk, comparatively few of these same well-informed people know the difference between a helix and a spiral. It is rather absurd that this should be so, because the distinction between the two terms is perhaps as great in the one case as in the other, and, also, in each case, each term is capable of clear and sharp definition, so that if we follow the definitions there is no possibility of mistake or of misunderstanding.

A helix the dictionaries define as the curve assumed by a line drawn on a plane when that plane is wrapped around a cylinder; while a spiral winds in a radial plane around an axis, constantly increasing its distance therefrom. So, by the definition, a corkscrew or any parallel screw thread is a helix, while a watch spring or a roll of carpet is just as clearly a spiral. The dictionaries then proceed to make a mess of it by making the two words synonymous and interchangeable, and they are not so much to blame for it, after all, as are the universal English-speaking people, for the dictionaries have abundant quotations from standard writers who use the word "spiral" especially for everything that winds around anything. And the words do run into each other rather confusingly when we get to applying them to sea-shells and many other natural and artificial objects that do not confine themselves strictly to the conditions. Who can say, for instance, whether the conical wire springs used upon the flat disk valves in steam pumps are helical or spiral? If, however, we stick to the definitions there is always a pronounced distinction between helical and spiral.

What started me on this was that I wanted to call the attention of folks to the fact that the chip made on the planer is spiral, while the chip made on the lathe is helical. You can, of course, get on the lathe a true spiral chip, as when you are feeding in a cutting-off tool; but I was talking rather of what we may call the typical lathe chip, when you are cutting the surface with a diamond point or its equivalent. We all know that the chip in such cases is a helical one, and, if the material is sound and tenacious, may be made of almost any length. It is my impression that chips have been made up to a mile in length, where special arrangements have been provided for winding. As might be expected from the lovely material worked, they make long chips at the Watervliet Arsenal when turning off the outside work of the guns. But you never hear of their making such long chips anywhere on the planer. They could not, of course, make a chip longer than the piece that is planed; but they don't do even that. The planer chip is spiral and rolls over directly upon itself, when it rolls at all, and unless the metal is extremely soft it breaks up into pretty short pieces. We may suppose that with a uniform cut and feed and material, the curvature of the chip, as it leaves the tool, will be constant, while the diameter of the chip roll will increase constantly, thus straining the chip more and more until the break occurs.

All iron and steel chips, as a rule, roll more or less as they leave the tool, instead of flowing away in straight ribbons. In turning cylindrical work, the outer edge of the chip, coming as it does from a larger diameter, flows at a higher velocity than the inner edge of the chip, and so, as it rolls over, it forms, for a single roll of it, a conical rather than a cylindrical figure. When the first circle is completed, and the first end of the chip gets around to where it started from, its shape is that of a frustum of a true cone, hollow of course, with both the large and the small ends true circles. That is, that would be the shape of it, only that before it gets there it comes in contact with the following chip, and is bent inward to a somewhat smaller circle so as to fold inside the following chip, and also, on account of its conical shape, sliding a little endwise or in the direction of the base of the cone, this continuous movement resulting in the helical chip.

Remembering how the chips always have to roll, it should be made a point of study to allow them to roll as freely and to get away with as little struggle as possible. Any interference with the absolute freedom of the chip after it leaves the point where it is torn away from the solid body of metal, means not only an additional amount of power required for the driving, but it also re-acts with a large leverage upon the cutting edge of the tool, largely increasing the pinch upon the angle of steel, and consequently increasing the friction, the heating and the abrasion.

Anyone who has tried it has found that, in turning external cylindrical surfaces, it is not well to set the cutting edge coincident with the radial plane, or exactly square with the axis of the cylinder. When this is done and the conical chip begins to roll away, the inner edge of the chip, as it rolls off, jams tight against the cylindrical surface already turned, and the resistance thus encountered re-acts and makes the chip, especially at its outward edge, pinch the tool harder than it would if it encountered no interference. By swinging the tool around, say 30 degrees from the right angle, the chip is given a much better chance to roll away without having to thrust against the solid metal and causing back pressure against the tool to pay for it. Back pressure is something that has to be paid for when the chip is getting out of the way, just as back pressure is always costly in the steam cylinder. This objection to the use of the cutting edge at right angles to the axis, does not apply to the internal cylindrical cutter, as in boring operations. The cutting lip of the half-round bit used at the Watervliet Arsenal for boring the gun barrels, as recently shown in these columns, is perfectly square, or at right angles to the axis; and as the chips curl away, they, of course, do not encounter the resistance due to a pressure against the small end of the cone, as there is nothing there to press against.

I am assuming all the while that the cutting edge of the tool, cutting as a lathe tool cuts, is straight on top—I don't say level, and flat in front; I don't say vertical, no matter how sharp the angle of the cutting edge—and that the chip, after it is severed, will be able to roll like any flat material, or with a constantly straight section at the point where the rolling is at any instant occurring. Remembering how the chip is always required to roll as it leaves the tool, it is evident that the straightness of the cutting edge is a matter of great importance; and yet it is the one condition that we are not always careful to comply with. If anyone will take a flat strip of paper, or of, say, thin sheet iron, and note how easily it may be rolled up, and then note the difficulty or the impossibility of rolling up the same strip if it is given a slight transverse bend, like a trough, he may be able to appreciate the task that is given the chip when a curved-faced tool is used in its production, instead of a flat or straight-faced one. If the chip is curved in transverse section, it must, after it is severed from the solid, be compressed at the edges and extended or torn in the middle, or vice versa, and this would seem to be useless and unnecessary if it could be avoided. In cutting V-threads, at least the finishing cuts, it cannot, of course, be avoided, and so the chips, in the impossibility of rolling out, are always minutely torn apart or crushed together, or usually both, as they flow.

There is quite a habit among lathe and planer men, especially with tools for heavy roughing chips, of giving the entire cutting edge a nice easy curve, instead of making it an absolutely straight line. So far as this habit is indulged in, it is evidently a bad one, as its effect must always be to make it more difficult for the chips to roll up. It may, perhaps, be better to have the actual corner of the tool rounded a little, so that it will not heat so readily; but beyond that there is no reason or excuse for curving the cutting lip of the tool. Even as to rounding the corner that is exposed to the heaviest of the cutting, it is rather questionable as to its necessity; I have never seen anyone who seemed to think that it was necessary to round the corner of the cutting lip of a twist drill. As the drill wears, the grinding of the flat of the lip seems to also sufficiently renew the corner.

Letters from Practical Men.

Planer Elevating Screws.

Editor American Machinist:

In your issue of January 28th I notice an article on "Special Planer Jobs," by John Randol, in which he proceeds to show why one right and one left hand elevating screw, as commonly made, are wrong, and simply indicative of a slavish worship of tradition.

Once upon a time I called at the works of the Gray Planer Company, of this city, and made the acquaintance of Mr. George Gray. It is generally known that the Gray Planer Company make an exclusive specialty of planers, and, I may add, of good planers, and they always use one right and one left hand elevating screw. I will confess that up to this time I was possessed of the same idea that now has its grip on Mr. Randol, and at the first opportunity I opened up the question, expecting to show Mr. Gray in a very few words how little he knew of the true inwardness of planer construction. In the course of the conversation which followed, I soon found that Mr. Gray is a mechanic, from the backbone out; that he does mighty little in obedience to New England or any other traditions, and that about planers he knows several things, if not more. He is not an aggressive man in conversation; but in that quiet way which best becomes the man who knows every inch of his ground, he proceeded to demolish my argument, and to sit down on my presumed knowledge of his own business, in a way which has had a lasting effect upon me. He started out by saying that he had furnished planers with a guarantee (which he was prepared to repeat to all comers) that the cross-rail should not vary from true parallelism with the table by more than one-thousandth of an inch at any position on the housings. I found it hard to frame an argument in reply to facts of this kind; but on expressing surprise (for I still had enough sand left to express surprise in a mild way), Mr. Gray proceeded to describe how it was done. He has one lathe whose lead screw is used for cutting elevating screws, and *for nothing else*. He also has another lead screw which is used for correcting the wear on the first one, and *for nothing else*. It is fair to assume that as many right as left hand elevating screws are cut, and that each one has a mate of the same length as itself. In other words, the wear upon the two sides of the first lead screw is as absolutely uniform as anything can well be.

In this system of production, the only objection to the right and left screw falls to the ground; while a system which divides a given amount of wear between two surfaces, which would otherwise fall upon one, has obvious advantages.

In corroboration of Mr. Gray's claims, I have seen a pair of his screws applied to one another. This is a very severe test of a pair of right and left screws, as the threads of one will fall into the spaces of the other—that is, they will if they are good screws, and they will not unless they are good screws.

Mr. Gray would, of course, be free to admit that if the lead screw were to be used for miscellaneous screw-cutting, the errors of the elevating screws could be best made to compensate one another by having them both of the same hand; but he is not making screws that need compensating; and it seems to me that the above recital of experience shows that whether right and left elevating screws are all wrong, or not, depends very much upon how they are made.

C. E. WILLIS.

Cincinnati, O.

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Machine Work in Coventry, Eng.

[The following extract from a letter by a young mechanic who recently went to England and found work in a bicycle factory in Coventry, will be found interesting.—Ed.]

Editor American Machinist:

Coventry manufacturers are very busy at the present time, and have been working overtime. American-made machinery is used a great deal, of all classes and makes. Methods and systems here are very backward, as well as the conveniences and mode of living. Coventry is a very old town and of about 65,000 inhabitants, eighteen miles from Birmingham. It used to have a large watch trade, but has lost most of it within the last few years, and bicycle manufacture is its chief industry at the present time.

A. H. NEWCOMB.

Coventry, England.

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German Machine Copying.

Editor American Machinist:

In going through the shops of a prominent German machine-tool builder who has been in the United States and got a good many ideas therefrom, as well as bought a good line of the best standard machines from which to copy or vary, in the production of his own line, I noticed that every solitary American machine, whether from Providence, or New Haven, or Cincinnati, had had the name chipped off and the place painted over. Visitors passing through (prospective customers are always escorted about so as to see what good facilities there are for turning out work, as well as to inspect in operation the machines offered for sale) were called upon to admire the beauty of design and finish and the quantity and quality of work turned out, by the sample machines, which were presented as the "old" design; the "new" or somewhat altered pattern being sometimes shown and sometimes not. The changes which would be made would be perhaps thickening up a lead screw, or paring away the housing of a tail-stock; and in every case the substitution of the German V side-clamp with two bolts for the regulation American tool-post in which the tool passes through the upright. Also, the Franklin Institute 60-degree thread with flat top and bottom on the lead-screw would be replaced by Whitworth round thread with 55-degree angle; and the assembling bolts were usually metric. As German cast iron is not so strong as American, and as German founders are hardly so expert, the frames were usually thickened up a bit. But so far as the central idea and the means of carrying it out are concerned, these tools are simply American out and out, "corrected for the longitude of Germany," as the astronomers would say.

Some of these tools are patented in Germany by their inventors; some are not. But patented or unpatented, there is a moral law which underlies all statutes, and which says, "Thou shalt not steal"; also a code of morality which says, "Thou shalt not lie." Now, a lie may be spoken or implied. The machinist who chisels "Brown & Sharpe" or other reputable name off a machine frame, is just as much a liar as he who, in response to a direct query concerning the machine, says, "This is my own make."

I know of one German who took the agency for an American pump maker who had built up a good business by good work and liberal advertising; bought a complete series of sizes, one of each size, and a few odd pumps for stock, and as soon as he got home, set to work to make counterfeits, which he sells as the genuine, in countries where the genuine are known and appreciated, and as his own where that would prove the best card. Here was even a meaner trick; for by taking the agency he threw sand in the American's eyes and prevented him from making other arrangements.

When a juror at the Paris International Exhibition of 1878, I ran across a showcase of locks exhibited by a German firm in competition for a medal, and which were not merely copies of American goods, but actual American locks, bought in Connecticut and tacked up against a maroon velvet background as of German manufacture. I exposed this fraud in the American papers at the time; but the same thing goes on, right under our noses, at nearly every exhibition in Europe.

We see Americans labeling California wine, and Hartford silk, and St. Louis cotton-seed oil, as of foreign manufacture, because they know that a lot of fools with money will pay a higher price for it with the foreign label than if honestly marked as of American manufacture; and then we go across the ocean and see Germany reversing the process for patriotic and commercial reasons—because they have pride in "Fatherland."

If their competition was confined to

Germany, the matter would not be so bad; but these Germans, with their cheap labor and pushing commercial methods, and admirable consular service, are selling right under our noses in countries which, geographically, we ought to supply.

I would counsel tool-makers to put their names on their output, not merely in letters which will require a good deal of chipping off or puttying up to efface, but in some peculiarity of rib or outline which would call for the whole machine to be gone over systematically. A comparatively trifling amount of alteration on patterns would give foreign purchasers so much trouble that the machines would be left recognizable under their proper paternity.

HUDSON.

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Reciprocating Parts of High-Speed Engines.

Editor American Machinist:

I write you for the purpose of expressing my entire concurrence in the view which has been so clearly and ably expressed by Mr. Griffin, in your issue of January 21st, on the proper use of the inertia of the reciprocating parts of the steam engine. There can be no question about the soundness of the position taken by Mr. Griffin, that this inertia ought to be sufficient to absorb at least all the steam pressure at the commencement of the stroke; and silent running cannot be relied upon in a high-speed engine unless this is done. That this important result is assured, by employing such weight and speed in the reciprocating parts that their inertia causes the steam pressure to come on the crank insensibly after it has passed its dead point, was fully demonstrated in the experiment described in my article in your issue of August 22, 1895, to which Mr. Griffin referred.

The question is pointedly suggested, why, when fully alive to the importance of this action, did I not avail myself of it during the long period when I was building the Porter-Allen engine. Why, on the contrary, did I continue to employ this inertia only to the extent of absorbing about one-half of the steam pressure at the commencement of the stroke? It will, I presume, be naturally assumed that I had good reasons for this course; but there will, quite as naturally, be a curiosity to know just what those reasons were.

Briefly, I did not employ the inertia of the reciprocating parts to a greater extent than I did, simply because I could not. The Porter-Allen engine was a simple, or single-cylinder, horizontal engine. In this engine I made the reciprocating parts as heavy as I could, with a solid, deep piston and exceptionally heavy crosshead and connecting-rod. At the speed I employed, their inertia would absorb, on the centers, only about 40 pounds per square inch of the steam pressure.

But why did I not run faster? Would not I have been glad to! First, I ran at the highest speed at which the engine would keep still. In a horizontal engine, the reciprocating parts require, theoretically, to be wholly counterbalanced. This, in a single crank disk, I could not do. Generally, no more than one-half of their weight could be balanced, and the unbalanced portion would begin to shake things if run any faster.

But, in fact, I had no encouragement to attempt the use of a larger counterbalance; for a higher speed was absolutely prohibited by the increased size of the ports and valves, that would be needed to get the steam decently in and out of the cylinder. This subject of waste room was full of difficulties, and caused me more worry and trouble, first and last, than all others combined. All I could do, I could not get it below about 7 per cent. of the piston displacement, and that amount was almost ruinous to the economy of the engine, involving an addition of fully 40 per cent. to the steam admitted, when cutting off at one-sixteenth of the stroke.

I had to confess myself beaten by these unfavorable conditions, in my attempt to utilize any further the inertia of the reciprocating parts, and just be content to do the best I could under the circumstances; but my dreams of the superior economy that was to be got by employing high piston speed were all dissipated by the greater loss in waste room, especially in short-stroke engines, that such speed, even to the extent that I used it, made unavoidable.

But we are at the opening of a new era. A radical change in the steam engine, already effected, renders this great object not only attainable, but that in a degree exceeding the wildest dreams that could have been dreamed, even ten years ago.

A vertical triple-expansion tandem engine can be run at a higher number of revolutions, giving a higher piston speed with a shorter stroke, and requiring not more than 4 per cent. of waste room to effect a better admission and release of the steam; and can develop an inertia in the reciprocating parts that will absorb all the initial pressure in the three cylinders combined, with a pressure of 200 pounds, or even of 300 pounds, on the square inch, admitted to the high pressure cylinder, running in absolute silence and without vibration.

To effect this grand result, the following features are necessary:

First—A compound, or better a triple-expansion tandem engine, in which great weight can be put in the pistons.

Second—A vertical engine, in which the reciprocating parts do not need to be balanced—in fact, must not be balanced—but only the crank and lower end of the connecting rod, on account of their horizontal fling; and in which, moreover, the heavy pistons cause no friction in the cylinders.

Third—Valves which require only one port for both admission and discharge of the steam.

These are the leading features which are required for the satisfactory solution of all these great engineering problems.

CHARLES T. PORTER.

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A Manufacturer's Views on Improved Twist Drills and Reamers.

Editor American Machinist:

The "American Machinist" is one of the few papers that we find time to read. We always look it over, and usually find something of interest and value to us. We have been much interested of late in the letters on twist drills and reamers. In a recent letter, your correspondent advanced the opinion that twist drills ought to be thinner in the center than the manufactured article is made at the present. While it is true that a twist drill will cut easier the thinner it is in the center, it is also equally true that it will the more easily split. In our experience we have found that ninety-nine drills out of a hundred that are broken in use, split from the point up the center, and if manufacturers were to reduce the thickness in the center, the proportion of broken drills would be enormously increased. In these days every shop has, or should have, a small emery wheel stand on which they can mount a small round-faced emery wheel, and they can thin the center of twist drills to suit themselves. It is the easiest thing in the world to find fault with what we have; but when changes or suggestions are made, many questions and conditions must be considered, and a manufacturer must make his goods to suit the average requirements, and cannot conduct his entire business to suit special requirements, or special conditions; he must make his goods so that he can sell the largest quantity to the largest possible number of consumers.

Now as to reamers; many suggestions have been made, in your columns, as to the proper method of fluting and grinding reamers. We have no doubt that a reamer made as suggested by Professor Sweet, would be a good one, and would make smooth round holes; but the difficulties in the way of manufacturing them in quantities, and at a cost sufficiently low to insure their being purchased, is quite another question.

The reamer mentioned by your Mr. Frank Richards in your January 28th number, with one flute straight and the next spiral, would also be a good tool, we think; but it, too, has the same objection as that raised against Professor Sweet's, viz., the difficulty of manufacturing the same at a low cost. We would gather from Mr. Richards' letter, that this idea of one straight flute and one spiral, alternately, was new with him; but such a reamer was patented October 17, 1882, by G. R. Vallentine, Patent Office No. 265998.

The writer's attention was called to this reamer at the time the patent was issued, and we inspected it, as we have many other things before and since, with a view to adopting it in our shops as a staple article of manufacture; but the difficulties in the way of turning out such tools cheaply seemed insurmountable. We have found that a taper reamer, especially one that is to be used in a drill press or other machine, works the best when milled with a left-hand spiral, but ground to cut when turning to the right. This overcomes the tendency which taper reamers have to grab, or run ahead, and they cut smoothly, as this kind of spiral gives a shearing and pushing tendency; in other words, the reamer has a tendency to back out rather than to draw itself in. Someone has recently obtained a patent on a spiral reamer with left-hand twists made to cut turning to the right. We have made such reamers away back in the seventies; but the question of patenting old articles is another subject.

J. D. Cox, Jr., Manager,
Cleveland Twist Drill Co.

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"Measuring Minute Intervals of Time."

Editor American Machinist:

In the issue of January 28th, there is a letter from Sir C. Purcell Taylor, Bart., D.Sc., under the above caption, in which he criticises and condemns the Boulengé chronograph, used by the United States Ordnance Department to determine the velocity of projectiles, as well as those other types that are dependent upon the vibrations of a tuning fork. His objections to the Boulengé are:

(1st) Great number of batteries needed;

(2d) Want of portability. These are not important, as batteries are not very expensive affairs, and the instruments are generally at a fixed location.

(3d) Delicate adjustment of resistance, and consequent

(4th) Trouble of getting ready for action, also do not count seriously, as the adjustments can be made and there is no need of special hurry; the objections are valid merely as to the convenience of use.

(5th) Variation with latitude, altitude, and hight of barometer. There is no especial difficulty involved in applying a fixed corrective for the first two sources of error; while for the last, a barometer reading will supply the data needed for its elimination.

(6th) Only one interval of time can be measured. It would occasionally be useful to be able to make several successive observations.

(7th) Owing to sluggishness of the magnets, errors arise which cannot be measured, and therefore,

(8th) The indications cannot be trusted; (7th) is really no objection at all, but only the basis for the (8th). However, the sluggishness of the magnets not only can be, but is allowed for, to within a sufficiently close interval of correctness.

Probably many readers are not familiar with the Boulengé chronograph. It consists essentially of a rod which is allowed to drop as the gun is discharged. The shot is made to cut a wire, which liberates a knife that strikes the falling bar and marks it. At a known distance from the first wire is stretched a second one in the path of the shot, the breaking of which liberates a second knife, which, in turn, marks the falling bar. The distance between the two marks is a measure of the time occupied by the shot in traversing the space between the first and second wires.

As regards the (1st) and (2d) objections to these chronographs, in which the vibrations of a tuning fork are used as a basis, density of the atmosphere, in affecting the rate of vibration, can be allowed for, as the density can be measured by barometer. Similarly, the effect of temperature changes can be eliminated.

But Sir Purcell Taylor does not only condemn well-known and long-used instruments, but states that he has devised a perfect one, which he terms the "Zamanap," but nowhere does he say a single word as to its construction, or mention the principle on which it is based, or refer to sources from which such knowledge might be gained. Possibly a hint as to this is contained in the name "Zamanap"; but to those poor mortals who do not understand Sanscrit, this is but the traditional "nod to a blind horse."

Undoubtedly, many readers of the "American Machinist" will second my wish for further information from Sir Purcell Taylor, who must be aware that the highest authorities are required to give particulars about their discoveries when issuing a statement as to having made them.

Henry Hess.

Newport News, Va.

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Clearance of Cutting Edges.

Editor American Machinist:

In the articles from practical men, anent the cutting edges of reamers, which have appeared in the columns of the "American Machinist" lately, there are some views expressed which I think to be opposed to the best shop practice. No cutting tool of any description will work well if it has not some clearance; by this I mean that the cutting edge which meets the work should be the highest, in order to sever the chips without excessive friction. If we take a planer tool and grind it flat on the bottom, it of course will not work properly; the reason is plain to any mechanic. If we take a lathe tool and grind it with just enough clearance so that it will cut freely on the center of the work, and then raise the tool slightly, it will not cut as well, the work having a ragged appearance. The reason of this is also plain—the cutting edge does not meet the work first, and the tool has to be reground for more clearance, and reamers are not an exception to this general rule.

I remember grinding some reamers once for a thoroughly competent machinist on general work, but who had the idea that reamers, as usually made, have too much clearance, so the orders were to leave the teeth of the reamers for a sixteenth of an inch back of the cutting edge, just as they were ground cylindrical in the machine; the clearance was to be made with an oil stone. The reamers were adjustable; the first hole reamed was in cast iron, and was polished beautifully, and just fitted the plug, but the reamer went tighter in the ring gage than the plug did. Then came some long, slender brass bushes; the reamer went hard; the oil stone was applied with vigor, and the reamer was set larger, until finally, when the plug fitted the hole, the reamer was about .003 larger than the plug. The bushings, of course, expanded while the reamer was being forced through, and all future reamers for that shop are probably ground with clearance.

The less clearance a reamer has, the longer it will last, and with no clearance it might last indefinitely; but it is better to have reamers wear out occasionally. A reamer with proper clearance will not chatter if started perfectly straight and there is not too much to ream out.

With regard to half-round center reamers, they will cut much freer if a flat surface is made and oil-stoned back of the cutting edge; and if E. Lawrenz will try one in his breast drill, I think he will find quite a difference.

J. T. Giddings.

Providence, R. I.

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That Untrue Engine Crank Pin.

Editor American Machinist:

It is always necessary that someone should find fault; you could not run a paper if there were not at least a dozen real chronic fault-finders scattered amongst your readers, ready to find fault with what you or some other fellow was doing. This is not in the way of finding fault, however; it is only in the way of objecting, not to the way a thing is done, but to doing it that way. I refer to the ingenious manner in which F. Fuerste & Son get the crank-pin journal true, as illustrated in issue of January 28th.

The objection may be well enough exemplified by supposing Fuerste & Son to have contracted for a new engine to drive their machinery. The engine is completed, and the builder explains that, through some blunder, the hole in the crank, for the crank pin, is out of line with the shaft. But, he remarks, rather triumphantly, the journal of that pin is true as a die with the shaft. Just center-end the pin once to turn the fit; then again to turn the journal. When you want a

new pin, all you have to do is to remember this and center the material twice, doing a little incidental filing and squaring and measuring on the collars. Would Fuerste & Son accept the engine after this altogether frank admission? Would they accept it, or—reflecting that just when a new pin must be had, they might both be traveling, for pleasure or business, in Europe or the Rocky Mountains, and that someone who was not nearer than a thousand miles of their place of business when the engine was bought, would probably make one new pin, re-bore the hole, and then make another pin before he got things turning around again—refuse to accept it until the hole was in line with other things with which it would popularly be supposed to be in line?

To put it another way, is not an engine mightily "out of repair" when the crank-pin hole is out of truth? And when the shaft is "in the shop" for a new pin, would not that be a real good time to put that particular detail of it in repair?

F. F. HEMENWAY.

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Small Cutting-off Tool — Two Towels.

Editor American Machinist:

The sketch herewith shows a cutting-off tool that I have found very useful in cutting off small stock, say from ⅜ inch down. I have used it on larger sizes, but not with very much success. The blade is a modern hard hack saw blade with the teeth ground off, or a little beyond where the teeth were, so as to get a good straight edge to it. The teeth were originally on the bottom of the blade, as the set to the teeth affects the blade for nearly one-third of its width, and if this edge were placed uppermost, it would not work so well. It is used on a small bench lathe whose tool post seat is always at the same hight.

The piece *a* is made of bar steel, with a slot on one side of just the width of the blade, and not quite as deep as the thickness of the blade. A sheet steel plate *b* holds the blade in place by means of the four screws shown. The upper edge of the slot is at the hight of the lathe centers, and the blade is sharpened by grinding the end, so it is always "on the center." For making small screws, etc., I generally have the blade set about as in Fig. 2, supported close up to the cutting point; but for cutting off brass tubes, the blade can be set out as in Fig. 3. The chips from cutting off brass tubes look like miniature clock springs, just after being wound. These blades have no side clearance, but they seem to cut all right. I use my worn-out saw blades for this purpose, selecting those that are practically straight in both directions; after removing the teeth that have not been broken in the primary field of usefulness, I grind both edges straight and parallel, to fit the slot in holder.

The first blade I fixed up was straight enough lengthwise, but I forgot to examine it as to its straightness in the direction of its width, and subsequently found it was slightly curved crosswise, so when I started to cut off with it, I found it insisted on steering over to starboard every time; but after a little experience, I learned about how much to cock the holder over to port, to make it cut off pretty near square.

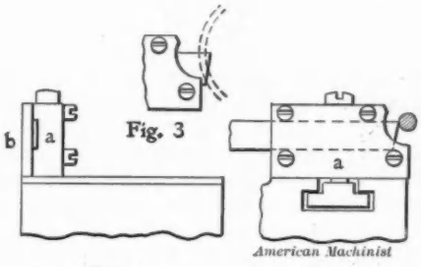


Fig. 1 Fig. 2 Fig. 3

SMALL CUTTING-OFF TOOL.

The only reason I do not bring an infringement suit against Messrs. Gould & Eberhardt is because I neglected to get the duplex towel business patented. I used two towels ten years ago, not exactly as they do, but one for "roughing" and the other for "finishing." It was simply a question of relative wetness; when the roughing towel got pretty well soaked, it was put in the wash, the finishing towel moved over in its place, and a fresh towel taken out as a finisher. In this way the towel had to earn its salary, and a fellow could get his hands and face dry every time without having excessive laundry bills.

WALTER GRIBBEN.

▲ ▲ ▲

Helical Reamer Teeth — Making Chips.

Editor American Machinist:

Mr. Richards sems to be all "off" on the reamer question.

First—The increased twist on a taper reamer, if much tapering, would do no good; the reamer does not go far enough, after it begins to cut, to get the benefit of the new angle.

Second—About the looks of the variable spiral, it is as beautiful a looking reamer as you ever saw. It is a reamer for 3-inch plug cocks, 5 inches at the big end, with 20 flutes, 9 inches long; a minimum spiral of 1 tooth, and a maximum of 2½. No one ever noticed the difference. It would simply surprise you.

Third—The increased twist for the straight reamer does do "O. K." I mentioned four flutes, because the way we had to make it was by using cruciform drill steel; heated it red hot and twisted it in a vise. By heating hotter at one end than the other, gave the increased twist. We could find no one who could cut increased twist left-hand.

There is no trouble in making variable twist flutes and keeping the faces of parallel width; it is simply using two cutters in pairs—one to cut the face, and the other to back off. The spiral is a temporary rig, a lever riding on an incline; the greater the incline, the greater the twist.

It does not seem to me that the article on "Making Chips" leaves much more to be said. I have, I suppose, already told too many times that the way to cut V-threads, when one has a lathe with a compound rest, is to set the compound at an angle of 60 degrees, and use the compound for taking the chip, and the cross-feed for withdrawing the tool to run back. I do not know that anyone has drawn particular attention to the fact that we use tools for cutting iron and steel with a great deal more acute cutting edges than could be used twenty or thirty years ago. This, I suppose, is due to two or three causes—cleaner stock to cut, very much better tool steel, and stiffer machines. This latter does not come in always, because we are all using tools, more or less, that are twenty to thirty years old. Perhaps we ought not to. Some may sell them as second-hand, but then the "other fellow" uses them.

One of my men was cutting some hard stock on a planer when the speed was pretty high, and his tool, which was thin, got hot and dulled. I said, when we used to have hard stock, we ground the tool square on the face. But he said: "If I grind the tool any blunter, it will dull quicker." This is somewhat in line with "making chips."

JOHN E. SWEET.

▲ ▲ ▲

Anchor Bolts.

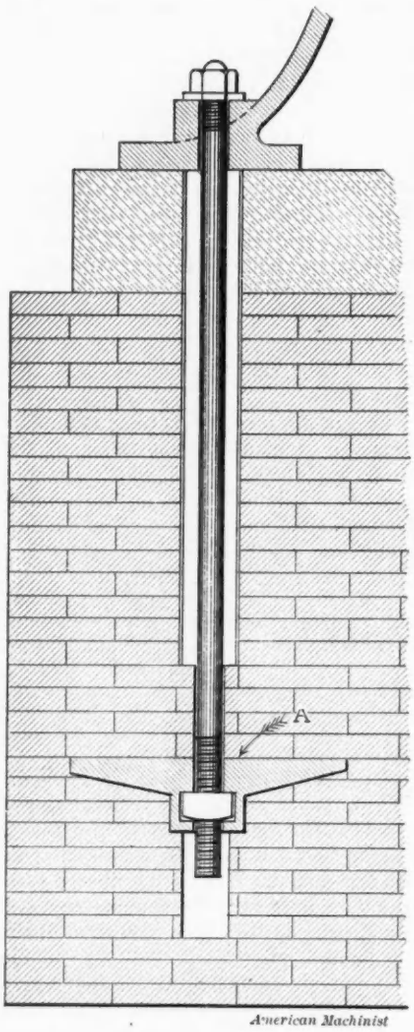
Editor American Machinist:

In reading the article lately published in your paper, concerning the repairing of anchor rods, it occurred to me that it might be of interest to some of your readers to show what is considered to be good practice for constructing and setting such rods by some engineers of this locality.

A is the washer built in the foundation, and has a pocket cast in same, containing the square nut on the lower end of the rod. This pocket holds the nut securely in place. The bottom end of rod being threaded for a distance of about 6 inches from the end, the nut is screwed on to about the middle position of this thread, before beginning the masonry work. An opening is left under the rod end; the masonry is built around washer and rod closely, and for about four courses of brick above the top of washer. The upper part is built in the usual manner, leaving a space around the rod, which is afterward filled with cement grout. It has been found that by using the long thread shown on bottom of rod, that a chance is offered to screw the rod either up or

down, as may be required, to allow the upper end to project exactly the right distance to give a proper finish to the work when completed.

This method was adopted several years ago by one of our leading firms, on observing in several cases where large engines were erected, that the templates had settled somewhat under the weight of the rods, which were of considerable diameter and weight, the result being that when the engines were placed on their foundations, the rods were too short on the upper end. This resulted in considerable labor in reducing the thicknesses of bosses on flange of base plates, in order to have rods extend through full thickness of nuts, which trouble has since been entirely obviated by use of method shown in sketch.



ANCHOR BOLTS.

This may not be anything new to engine-builders, but may interest some one of your readers, and I submit it for your consideration. It is a matter of small detail; but it is the small details, carefully looked after, that help to give general satisfaction with any device.

HUGO A. HECKER.

Bellevue, Ky.

Grooving Twist Drills.

Editor American Machinist:

The "American Machinist" of December 17th last prints an article descriptive of certain improvements in twist drills, which article includes a cut and description of grooved drills.

The credit for the invention is apparently given to an inventor of Berlin, Germany, but it would seem that at least a portion, if not the whole credit belongs on this side of the water, and it is to this end that I call your attention to the fact that a Bridgeport inventor made and tried drills of the same design with great success not less than three years ago. At the same time he made application for a patent, and found, upon making the preliminary examination, that the same improvements had been patented as far back as December 22, 1868; and I inclose a copy of this patent, granted to C. W. Le Count, of Norwalk, Conn., and numbered 85107.

It seems to me, as it does to the Bridgeport inventor mentioned, that the improvement originated in the State of Connecticut, and not in Germany.

J. G. LEPPER.

Bridgeport, Conn.

[The patent from which we reproduced the cuts upon December 17th, was a United States patent, although the inventor was a resident of Germany. The claim was upon the shape of the grooves, and did not, of course, cover the entire drill-grooving idea.—Ed.]

▲ ▲ ▲

An Automatically Releasing Check Valve.

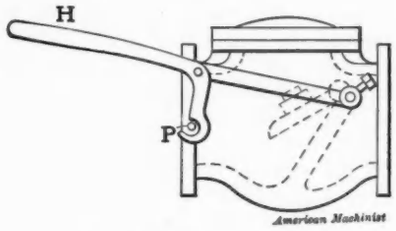
Editor American Machinist:

Some time since we found it necessary to improve our means of obtaining water at an elevation of 41 feet; we also were obliged to use a much larger quantity at about 10 feet elevation; but on account of the supply being furnished by a ram, it was at times necessary to supplement the amount the ram would furnish direct by drawing from the upper tank, and to accomplish this was the object of the described construction.

In the delivery pipe from the ram to the upper tank, which pipe is also used for the supply pipe at the lower level, after passing all the draft openings on the lower level, we put in a regular Pratt & Cady swinging back-pressure valve to act as a check against the heavier pressure, but have so fitted this check as to be fastened open, when desired to draw water from above, and to make its fastening self-tripping when the desired quantity has been drawn.

The accompanying sketch shows the construction quite plainly, the valve being in the open position; the only points not at once apparent are, that the keyway in the valve carrier is considerably wider than the feather in valve spindle, thus allowing the valve to swing easily on the spindle, and act as an ordinary check, while it can be as easily lifted by a rotation of the spindle.

The holding device is but a single piece, forming also the opening handle *H*, and pivoted on the regular weight lever as shown; the notch to engage the pin *P* is but slightly hooking, so that if a discharge valve is opened and the supply found inadequate, the check may be lifted by this handle *H*, the hook engaging with the pin *P* in flange, when the pressure of the current against it (it being only about half opened) causes enough tension to keep the lever handle in the hooked-on position as shown, but as soon as the discharge is closed and equilibrium established, the weight of the handle trips it off, thus allowing the valve to act again as an ordinary check.



AUTOMATICALLY RELEASING VALVE.

CHARLES S. BEACH.

▲ ▲ ▲

Holding Work on the Planer.

Editor American Machinist:

If "Junius" will put a stop in the hole at the end of the piece shown in Fig. 3, page 29, issue of January 21st, and let the piece come against the stop, it will be less likely to work loose when being planed. The stop should be short enough to allow the tool to pass over it. A few stakes made like the sketch could be used where the ordinary ones would turn.

NOVA.

▲ ▲ ▲

Weight of Cast-Iron Balls.

Editor American Machinist:

The formula you give in January 21st number of your paper for weight in pounds of cast-iron balls, namely, $D^3 \times 0.1365$, in which D = diameter in inches, may also be written $R^3 \times 1.092$, in which R = radius in inches. From the formula in this form, we can deduce the rule for rapid approximation: Cube the radius in inches and add ten per cent. for weight of ball in pounds. The result will be a little less than one per cent. too great. G.

▲ ▲ ▲

Ten locomotive works in Great Britain employed, in the aggregate, the following numbers of men: 9,971; 9,043; 8,251; 8,473; 10,910, for the five successive years 1892-1896, inclusive, the last year showing quite a gratifying increase.

A Pulley Stock List and Storage System.

BY S. E. FREEMAN.

Having had the problem of storing and indexing a large stock of pulleys in a pulley factory to deal with, I devised the following system, which has given excellent results and saved a large amount of time. Ruled stock list sheets were prepared, each sheet being devoted to a single diameter of pulley. A short section of the ruling is shown at the bottom of the sheet of directions, Fig. 1. When pulleys are added to the stock, they are indicated by marks upon the left of the sheet, and when pulleys are removed from the stock, these marks are crossed out as shown, the number of remaining uncrossed lines indicating the number of pulleys on hand. The pulleys are stored upon a rack, roughly sketched in Fig. 2, the larger ones being placed at the bottom. The lists shown in Fig. 1 are kept upon a common bill file, and with them are filed additional sheets, showing the section of the system of racks in which pulleys of different diameters are kept. Upon each pulley, when put in the rack, is pasted a ticket, shown in Fig. 3, which indicates at once the various dimensions of the pulley, without removal from the rack in order to measure it. This system takes the place of no system, the pulleys being formerly kept without any attempt at classification, so that a call for a pulley necessitated a hunt through the stock with a scale and calipers, with the expenditure of time and wages, to say nothing of the danger of missing just the pulley wanted. The plan shown, it is needless to say, has saved all this expense and been a source of comfort and satisfaction.

LIST OF PULLEYS IN STOCK.

Directions.

1. There are four columns to indicate the number in stock, and this allows space for 20 pulleys. Should there be more than 20 pulleys of one kind in stock, begin on a new line.
2. When a pulley is added to stock, draw a straight line, thus *I*, for each one added, and only five lines to be put in each column.
3. When a pulley is taken from stock, draw a line forming an *X*, which, for each *X* drawn, denotes one taken.
4. Begin the lines at the first left-hand column.
5. Begin crossing off the lines at the first left-hand column.

SPECIMEN

NO. IN STOCK				FACE	BORE	HUB DIAM.	HUB LENGTH	REMARKS
XXXXX	XXIII			10	$2\frac{3}{16}$	$4\frac{3}{8}$	6	2 S. S.
IIIII	I			12	$2\frac{15}{16}$	$5\frac{1}{4}$	8	K. S. & S. S.
XXXII	IIIII	IIIII	II	6	$1\frac{11}{16}$	$3\frac{1}{2}$	4	Tight & Loose
XIII	I			12	$2\frac{15}{16}$	$5\frac{3}{4}$	8	D. B. K. S.

Diameters of Pulleys will always be found at bottom of each sheet. *American Machinist*

Fig. 1

Average Yearly Income of Machinists.

The Bureau of Labor Statistics for the State of New York has been investigating the subject of the average wages paid in different industries, and the figures have been published, giving the average annual income to workers for the five years, 1891 to 1895, inclusive. In the line of "machines and machinery, etc.," the figures are as follows: 1891, $601.29; 1892, $575.28; 1893, $567.94; 1894, $559.56; 1895, $536.51.

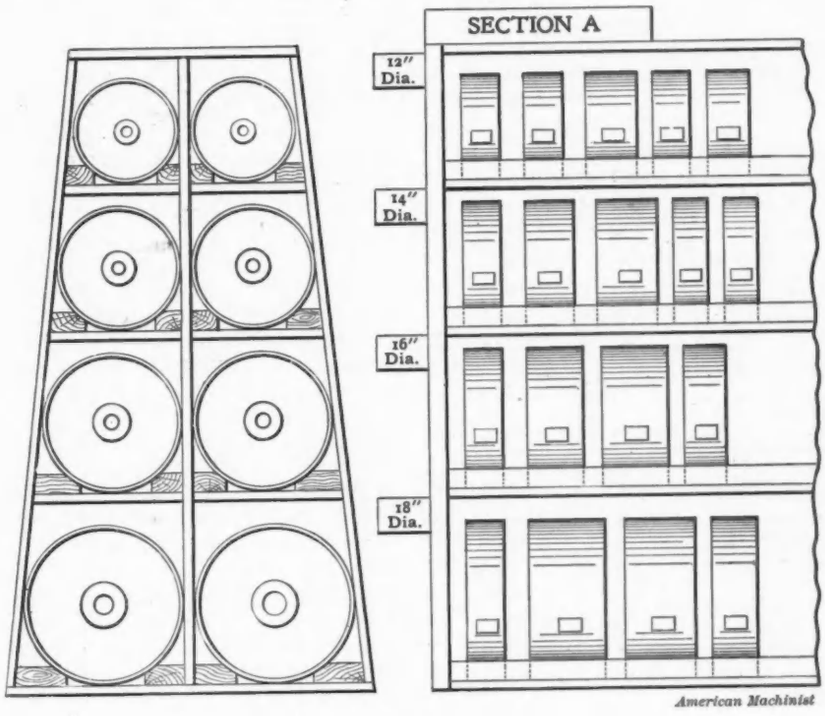


Fig. 2

PULLEY STORAGE RACK.

FACE	10"	REMARKS
BORE ~~CORE~~	$2\frac{3}{16}$"	2. S. S.
HUB DIAM.	$4\frac{3}{8}$"	
HUB LENGTH	6"	
Put in Stock	7/18/95	by J. O. B.

American Machinist

Fig. 3

A report comes from Japan to the effect that they are already experiencing some of the labor difficulties which usually attend industrial development. It seems that, warned by experience in other countries, Japanese cotton manufacturers had agreed among themselves not to employ workmen who had been dismissed, or had left the mill of any member of the combination. Had this plan been entirely successful, it would, of course, have placed matters entirely in the hands of the manufacturers; but one establishment refused to go into the agreement, and hired some female operatives who had left another mill. Thereupon the dealers in cotton goods were called in for assistance, and instituted a boycott against the dissenting mill.

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There has been of late an unusual epidemic of broken shafts at sea. In the months of December and January no less than ten steamers in the North Atlantic alone were disabled in this way, seven of their number being picked up and towed to the nearest port, while three managed to get in under sail.

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The Hardest Job of All.

Machine building from any point of view is a hard and laborious business. The physical hardness of the materials employed would seem to have impressed itself upon the entire business, and the labor and care necessary for good results in the shop are fittingly matched by the corresponding labor required in both drawing office and business office to cope with the variety and minuteness of detail involved at every step. Nevertheless, there is probably no business followed by men in the pursuit of a livelihood, to which its followers are more devotedly attached than this. The born mechanic loves the shop; loves even its difficulties and its trials; loves the machines which are the embodiment of his own triumph over these difficulties, and has even a measure of affection for the scrap heap which embodies his failures.

There is, however, another class of difficulties connected with the business, in contending with which we have never known a mechanic to rejoice, whether success or failure attended his efforts. We refer to the difficulties placed in his path by the ignorance of mechanical principles on the part of those connected with the business management. It is an old story. We hear of instances many times a year, and the individual cases have a striking similarity. A mechanic finds himself in a shop which, in the march of progress, has been left in the rear. The managers have had the logic of the situation forced home by the testimony of the balance sheet, and feel that they must "do something," and perhaps have engaged a new superintendent with that in view. He enters upon his duties with a light heart. Here is a job involving hard thinking and hard work, but the opportunity is great and the path is clear. It is for this he has been trained; and while the difficulties are great, they are of the kind he rejoices in facing and overcoming. He finds an entire lack of system, and proceeds to introduce systematic methods; then the trouble begins. The management have the clerical labor involved in these methods before them, while the savings produced are obscured in the general outlay for the shop, and no disposition to appreciate or even investigate these savings is shown. Proceeding further, our superintendent asks for some new tools to supplement the existing equipment, composed of lathes, planers and drill presses, the intention being to introduce modern methods for cheapening work, and doubts as to his mechanical judgment immediately arise. When told that these tools are in everyday use elsewhere, the sufficient answer is: "The conditions are different; our work is special; what others do is no guide for us, and it is all theory, anyway." Perhaps some of the desired tools are bought to test the new "theory," but the old cost accounts have been kept in such a slovenly manner that no comparisons of any value can be made, or if in isolated cases such comparisons are possible, they are looked upon as exceptional and of little significance. And so it proceeds to the end of the chapter. Perhaps in the end the shop is put upon a fair basis, but the ill feelings engendered in the process obscure everything else, and, more than likely, concessions made by the superintendent on some points, in order to secure others, lead the business managers to conclude that, after all, the results secured are theirs and not the superintendent's.

The picture is not overdrawn. Human nature has many curious manifestations, and the business head of a mechanical business, if ignorant of the mechanical side of the business, and somewhat opinionated in addition, is in a position where human nature often shows itself at about its worst.

Our feeling when contemplating a situation of this kind is always to advise the superintendent to quit on the spot. The ancient Greeks had a proverb: "Against stupidity even the gods contend in vain," and another fable teaches us that the leopard does not change his spots. Shops can be made over and their youth can be renewed; but men, never. It is better to stop with the work undone than to struggle through all difficulties, only to be damned with faint praise at the end, with the opinion: "Oh yes; he is a good mechanic, but expensive in his ideas, and ignorant of business considerations." It is a fair question if a firm or corporation which has allowed its works to get into a run-down condition, is not, by that fact, condemned, and if its rejuvenation is not a hopeless undertaking from the start.

▲ ▲ ▲

What constitutes the production of a machine? Ordinarily, we would say that when the machinist has given it the last touch of emery-cloth and the last dab with a piece of waste, the machine has then been "produced." But effective production means more than this. The effective production of the machine is not really complete until it is in the hands of its user and he has accepted it. Where a machine is to go to a foreign country, this usually means that it must be packed for shipment in quite a different manner than where it is to go by rail only, and this matter of packing machinery for export is one which has been in some cases more or less bothersome. The best efforts of the designer and the constructor to please a foreign customer may readily be frustrated by the packer, who may so pack a machine as to make it almost inevitable that the receiver of it will be displeased. We are glad, therefore, to publish on another page of this issue a letter giving the result of long experience in this line.

▲ ▲ ▲

George B. Roberts and His Successor.

The late President of the Pennsylvania Railroad, George B. Roberts, who died on the 30th ult., was a man who had attained, and for years held, his position at the head of one of the greatest, if not the greatest industrial and business organization of the age, because, first, he had natural abilities of a high order, and, second, he was willing, and actually did work continuously as hard as nature would permit him—in fact, perhaps harder than a wise consideration for his own physical welfare would have dictated. Added to this was his sterling integrity, which gained for him the implicit confidence of all who came to know him.

Mr. Roberts began life a civil engineer, and was employed in that capacity by the company in whose service he died; his advancement from one position to another, and finally to the presidency, being simply nothing more than the recognition of the fact that he was the man best fitted for preferment.

His successor, Frank Thomson, had been the First Vice-President of the com-

pany, and is a practical railroad man, having entered the Altoona shops of the road at seventeen years of age. He afterwards became superintendent of motive power, and was advanced from one position to another in recognition of his able services to the road.

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Samuel R. Wilmot, of Bridgeport, Conn., President of the Wilmot & Hobbs Manufacturing Company, died on the 4th inst.

▲ ▲ ▲

M. Martini, inventor of the famous Martini rifle, died at Frauenfeld, Switzerland, on the 1st inst.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

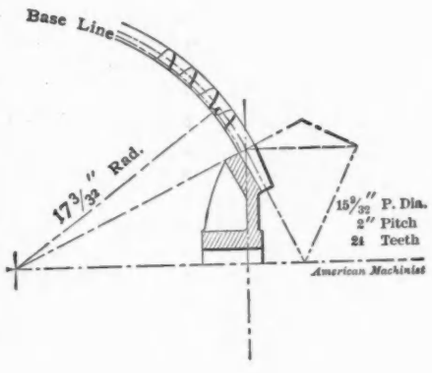
(11) H. E. B., Whaleyville, Va., asks: 1, In packing a flange or cylinder, when red rubber, or any other rubber, is used, should oil or grease be applied? A.—No; the surfaces should all be clean. 2, What is the best lubricant to put on a bolt that is 4 inches diameter and has three threads to the inch? The bolts are used in the main bearing of a gang, and we have lots of trouble in getting them loose. A.—We would use tallow liberally, both on the threads and on the bearing faces of the nuts.

(12) J. W., Minneapolis, Minn., asks if all kinds of iron ore are magnetic and can be located by the magnetic needle. A.—No. But one iron ore, properly so called, is magnetic—magnetite or magnetic iron ore. This is the richest of all ores in iron, containing, when pure, 72 per cent. of the metal. Another ore, called Franklinite, is also magnetic; but this is an ore of iron, zinc and manganese, and is properly a mixture of magnetite with oxides of zinc and manganese, from the first of which it derives its magnetic properties.

(13) W. D. M., New York, asks: In the construction of microscopes such as are used on measuring machines, and of telescopes such as are used on transits and other engineering instruments, where should the silk fibre be placed with relation to the focus of the lenses? A.—For the finest work, spider webs are used instead of silk fibre, and will generally be found much superior to silk. The position of the spider lines or cross-hairs, as they are sometimes called, should be in the focus of the eye-piece. They are usually placed as near the focus as possible by construction, and the eye-piece is then arranged to be moved to or from them to secure a sharply defined image.

(14) A. C. P., Baton Rouge, La., asks: In the construction of engine lathe headstocks, how are the live spindle bearings lined up so that when a piece of work is clamped to face plate it can be bored parallel from end to end? A.—The same method is not followed in all cases for doing this. The usual and what may be called the older method is to first bore and fit the bearings, and then plane the headstock to fit the bed, holding it upon the planer by an arbor passing through the spindle bearings. In some cases this has been assumed to bring the spindle sufficiently close to accurate alignment, but in other cases where more accurate results are wanted, an arbor carrying a sweep at its outer extremity is placed in the bearings in place of the spindle, and this is rotated from front to back and tested to see that the arm attached to said arbor moves in a plane at right angles to the shears of the lathe, and if it does not, then the V-grooves in the headstock are scraped until the alignment is correct. Another method now followed by some builders is to first plane and scrape the headstock to a fixed standard, and then bore the seats for bearings with a boring bar passing through bushings known to be in perfect alignment with the seat to which the headstock is secured in the fixture, the boring bar being driven by a universal coupling, so as to be unaffected by any want of precise alignment between the drill press or boring machine spindle and the fixture.

(15) S. E. D. writes: Which of the following methods is correct for determining the shape of teeth on bevel wheels? The wheel shown on the accompanying sketch may be taken as an example. A table giving the radii of face and flank on teeth, for wheels of different numbers of teeth, to be used—such a table as Grant's, for instance. There are 24 teeth on the wheel. The pitch is 2 inches. The cone, represented by the bevel wheel, when developed, would form part of a circle 17 3-32 inches radius. The circumference



of a circle 17 3-32 inches radius contains 54 spaces of 2 inches each. In one case the radii given in the table, for face and flank of teeth, of a wheel containing 24 teeth (the actual number in this bevel gear), were laid off on the circle of 17 3-16 inches radius; this curve was taken as the shape of the teeth. In another case the radii of face and flank, given in the table, for a wheel of 54 teeth (54 is the number of 2-inch spaces in the circumference of a circle 17 3-16 inches radius), were laid off on the circle of 17 3-32 inches radius, and the curve obtained was assumed as the shape of the tooth. Giving the above in another way and using Grant's Table; would the base line, from which the curves of the tooth are drawn, be 1-60 of the pitch diameter of the wheel (15 9-32 inches), or would it be 1-60 of the diameter of a circle whose radius is 17 3-32 inches? A.—The teeth must be drawn in all respects as for a spur gear of 17 3-32 inch radius, both as to tooth curves and as to base line. This is known as the "Tredgold" method. See sections 161 to 166 of Grant's "Treatise on Gears."

Personal.

Mr. J. D. Stiles is now in charge of the Boston store of Jenkins Bros., at 17 Pearl street, that city.

Assistant Engineer George W. Danforth has been ordered to duty at the New York Navy Yard.

H. M. Norris has recently become inspector at the shops of the Garvin Machine Company, New York.

At the annual meeting of the Deane Steam Pump Company, of Holyoke, Mass., J. G. Mackintosh was elected a director in place of the late Harvey Heywood.

We shall be glad to publish personal notes of interest concerning men connected with machinery interests, and will esteem it a favor if our friends will send in items of information regarding changes in personnel, foremanships, superintendents, etc. Most men like to know where their friends are and what they may be doing, and to keep track of changes taking place in shops in which they may have worked or have some interest. The "American Machinist" can be made the medium for the exchange of such information, if our readers will take the trouble to send us items of information.

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Commercial Review.

NEW YORK, SATURDAY EVENING, FEB. 6TH.

DYNAMOS AND MOTORS.

In the market for electrical machinery, sluggishness still dominates, as in truth it does in most other lines of trade. The first month of 1897 has been unsatisfactory, as an auspice of business generally. The attempt may be made to explain this on the ground of an approaching change of Administration and the probability of a revision of the tariff, but the cause seems to us to be more fundamental. It is Inertia, and the inertia of the business of a great country like this is no inconsiderable quantity. It is like a big rolling cannon ball, which is easy enough to stop by interposing a rock in its pathway, but very hard to set in motion again when it is once brought to rest.

In the street railway line, if the experience of one or two important companies may be taken as a criterion, there is not a great amount of scattering work, among the small towns, etc. There have been a few large contracts let, principally confined, however, to the East. The General Electric Company will supply machinery to the Fourth, Sixth and Eighth avenue surface lines of this city, to be used with the underground conduit system of electrical transmission, which will be laid from the Harlem River nearly to the Battery. The West End Street Railway, of Boston, has placed a good-sized order for motors with the same company.

who are now running with full force, full time.

In electric lighting dynamos there is not as much doing as there might be, but in this one branch of the market, in this locality, there is a fair amount of business definitely in sight, because something like a dozen buildings which eventually will need generators are nearing that stage of construction when the letting of contracts may be expected. This phase of the electrical trade is indeed small in comparison with its entire scope, but it is enough to make considerable difference with a number of local concerns.

The motor business pursues the even tenor of its way without great show of activity, but always something doing. Certain companies report good sales or prospects. It stands to reason, however, that until factories get upon a better buying basis the demand for electrical motors must be restricted.

EXPORT ITEMS, ELECTRICAL AND OTHERWISE.

Some American, as well as English and German, electrical companies have been making bids on lighting plants in Japan, which will involve contracts to the value of $750,000.

The European nations have evinced qualities of remarkable resiliance, as compared with our own, in recovering from the business depression of this decade.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 16.

Scientific Machinist, Cleveland, O., wants agents.

Fine pattern castings. H. D. Phelps, Ansonia, Ct.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Modern Steam Engine Design. Working drawings of how to build a steam engine. Parts 1, 2, 3, 4 and 5 now ready, 30 cents each, all blue prints. T. F. Scheffler, Jr., Erie, Pa.

The American Ball-Bearing Co., of Cleveland, have exceptionally good facilities for the manufacture of bicycle cups and cones; tempering, case hardening and grinding are a specialty with them.

▲ ▲ ▲

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Wanted—Position as brass f'ndry foreman; thoroughly experienced. Address Box 66, AM. MACH.

Wanted—Pos. by draughtsman; 7 years' experience; tech. education. Ad. Box 63, AMER. MACH.

Engineer, drafts. and inventor desires to engage with respon. firm. J. H. Fedeler, 456 W. 22d st., N. Y.

Wanted—Pos. as draftsman by tech. man; 3 yrs. exp.; good refs. if wanted. Box 61, AM. MACHINIST.

Wanted—Position as foreman of machine shop by man of experience and thoroughly up to date; A 1 reference. Box 67, AMERICAN MACHINIST.

Wanted—Pos. as travel. salesman by jour. mach. and drafts.; accustomed to mach. tools; aged 23; strictly temperate; cor. solicited. Box 64, A. M.

Wanted—Position as assist. supt. or foreman, by practical man; 3 yrs. experience in shop and drawing room; tech. grad. M. E.; refs.; 26 yrs. of age; American. Address AHORA, AMER. MACHINIST.

Situation Wanted—Draftsman and designer, automatic high speed engines and special machinery; technical education, good machinist, modern methods, age thirty-six. Box 70, AMERICAN MACHINIST

Wanted—Position by a thorough practical mechanic, A 1 machinist and draftsman, well posted in designing and getting up general and special machinery for all purposes, high speed steam and gas engine. Box 68, AMERICAN MACHINIST.

Wanted—Position as superintendent or foreman of machine shop and forging department, or of a manufacturing plant; mechanical and executive ability united; experienced; can give good refs.; age 37. Box 60, AMERICAN MACHINIST.

A skilled designer and builder of special machy. is open for engagement; many yrs. exp. in originating and perfecting automatic machy. and improving mfg. processes; highest ref., covering entire record. Address Box 65, AMER. MACHINIST.

Help Wanted.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—Agents to sell Globe Drill Chucks as a side line; liberal commission. Address Globe Chuck Co., Washington, D. C., U. S. A.

Wanted at Once—One first-class machinist; one that can work and take charge of men doing general jobbing and building special machinery; state age, wages expected, also references. Box 55, AMERICAN MACHINIST.

Wanted—An experienced pattern maker to take charge of pattern shop in architectural iron works; must be thoroughly familiar with stair work and all kinds of ornamental iron work. Address James McKinney & Son, 925-933 Broadway, Albany, N. Y.

Wanted—Two or three good general machinists, and two good general moulders for shop, manufacturing engines in Western Pennsylvania. Address, stating age, experience and habits, to "Foundry," care AMERICAN MACHINIST, New York City

Wanted—A first-class designer of modern light machine tools; position open abroad in a large manufacturing establishment; no applications can be considered except from thoroughly capable men; suitable salary will be paid. Reply, giving full details as to qualifications, to box 56, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., of Spring and Varick streets, New York City.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Gas engine patent with patterns for sale; good opportunity for manufacturer; simple, durable and reliable; several running. Box 69, AM. MACHINIST

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

For Sale—Blakeslee Bolt Header, size C, heads 5/8 to 2½ inch bolts; 40 lb. Bradley Rubber Cushion Helve Hammer; No. 4 Emerson Power Scale. Practically good as new machines. Address H. T. Marshall Machine Co., Brockton, Mass.

We are surprised at the patronage our machine builders are receiving from abroad, and yet through various channels comes the information that European shops are filled with orders far ahead, and that it is the overflow which is falling to us.

For the benefit of those who wish to seek Russian trade, we would call attention to the fact that an attempt is being made by a firm of Russian exporters in this market, and diplomatic aid being solicited by them for the purpose, to interest Americans in the fair held yearly at Nishni-Novgood, during the six weeks beginning June 15th, or to induce them to place their goods on exhibition in Moscow. The firm is W. Toritch & Co., and they say that the yearly exhibits at the Nishni-Novgood fair in 1894 and 1895 were about $90,000,000 in value.

Machinery is already being sent from here to the Brazilian Permanent Exhibition of North American Industries, which is to be established in Rio de Janeiro and San Paulo.

Doubtless, some people regard Cuba in its present bellicose condition as virtually erased from the business map. Such may be surprised to learn that a Cortlandt street export house has just received an order for two water-tube boilers of 200 horse-power each, for electrical purposes in Havana; and they believe that more trade is to be expected in the future.

Inquiries come from Japan for 25 tons of punched boiler plate; from Colombia for brick machinery and stone-cutting ditto. For upright engines and boilers of from ten to twenty horse-power there is some demand in the interior of Venezuela.

Our summation of items of machinery, so far as distinguishable, in daily reports of cargoes foreign bound from the port of New York made public during the week ending January 30th gives, in round numbers $325,000, and for the week ending February 6th $340,000.

STRAWS.

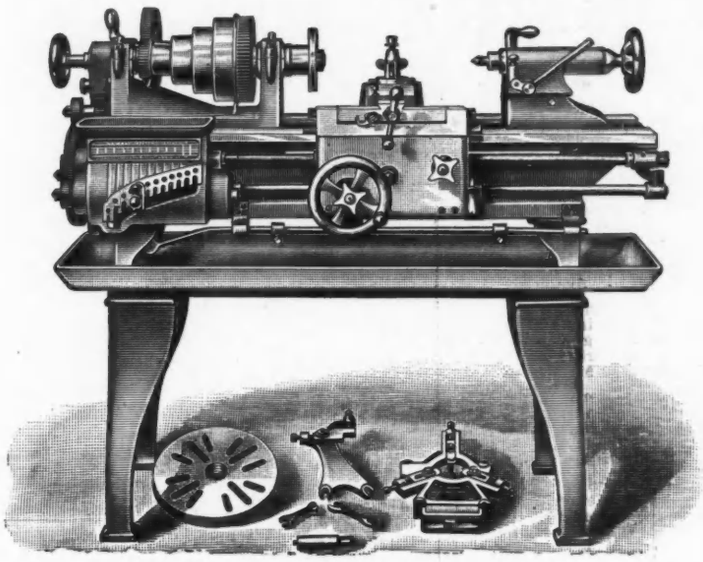
Mr. H. S. Peters, overall manufacturer, of Dover, N. J., reports that his sales have increased 65 per cent. within a month or so; which looks as though some people were going to work. Perhaps they are machinists.

The Link-Belt Machinery Company, of Chicago, in a circular letter, report that while they are not at the present time overcrowded with work, they are running their regular force full time. During the last few weeks a gradual improvement has, they think, developed, and the signs point to increased activity in all departments soon. Important orders have come from the largest sawmill in Canada, a leather factory in Wisconsin, and a coal-washing plant in Ohio.

THE IRON MARKET.

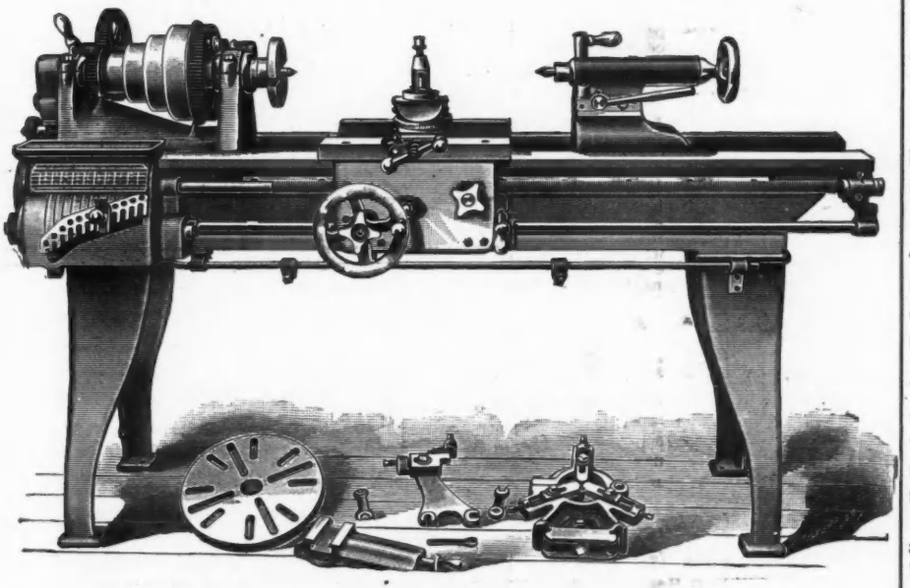
It certainly does not auger favorably for the iron trade that so influential a con-

(Continued on page 39.)



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: Chas. Churchill & Co., London and Birmingham, Eng.
Schuchardt & Schütte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

(Continued from page 38.)

cern as the Illinois Steel Company has made a cut of 15 to 20 per cent. throughout its pay-roll, from the president down.

The pig iron market is still slow and disappointing. The outlook for future business in structural material has been pronounced bright, owing to various building operations.

PITTSBURG REPORT FOR JANUARY.

Trade shows little or no change in this district. The conditions of affairs are such as to cause much discouragement, as many were of the belief that as soon as the new year made its appearance business would assume a little heavier proportions. The only line of trade in which any life seems to be shown is the structural material, and that was caused by a few comparatively large contracts which were let a short time since. The complaint made for many weeks past in regard to a want of interest in business, is still being heard on all sides. In all branches there is still the same disposition to hold back and await coming events.

Many manufacturers are still contemplating improvements. These have been deferred since last summer, and, judging from present appearances, it will be almost next summer before the plans will be fulfilled. There has lately been considerable talk among steel manufacturers, regarding the changing of their plants for the manufacture of open-hearth steel instead of Bessemer steel. Those which have undergone these improvements most recently are the Ohio Steel Company, of Youngstown, and the Junction Iron & Steel Company, of Mingo Junction, O. The former has already broken ground for ten 40-ton furnaces, and the latter will erect ones of almost similar size. A small plant of this character will be constructed at Braeburn station, on the Allegheny Valley Railroad, by William Metcalf, of the Ferguson Block, Pittsburg. These, which are but a few of the many improvements contemplated, will be pushed immediately toward completion.

In the machinery lines, but few contracts are being awarded at present. Plans have been laid aside and will be undisturbed until a better feeling prevails. The few orders going are only for immediate wants. In the boiler and engine trade, nothing of special mention can be said. None of the large boiler companies have closed contracts that would make a good showing. The agents of some of the smaller concerns have been placing some power installations in the coal-mining districts for hoisting purposes, and for pumping purposes in the oil trade. These generally vary from 50 to 100 horse-power, and consequently cut little figure.

Mill supplies are in slack demand, and prices are not what they should be. It was thought by many that new price lists would prevail after the turn of the year, but such was not the case. A few sent

out new lists, which showed some advance, but they were soon recalled, owing to the depressed condition of affairs.

Quotations.

NEW YORK, Monday, February 8th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 50 @ 11 75
No. 2 plain, Northern	10 75 @ 11 00
Gray Forge	10 50 @ 11 00
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 25 @ 10 75
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 50 @ 10 75
Foundry forge, or No. 4 Southern	10 25 @ 10 50

Bar Iron—Base—Mill price, in carloads, on dock common, 1.05 @ 1.10c.; refined, 1.10 @ 1.40c. Store prices: common, 1.35 @ 1.45c.; refined, 1.40 @ 1.60c

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, 1.60 @ 1.65c.

Cold Rolled Steel Shafting—Base size, 2.60 @ 2.65c., from store.

Copper—Carload lots, Lake Superior ingot, 12.00c.; electrolytic, 11⅝ @ 11¾c.; casting copper, 11½ @ 11⅝c.

Pig Tin—For 5 and 10-ton lots, 13.60 @ 13.70c., f. o. b.

Pig Lead—In carload lots, 3.22½ @ 3.27½c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10 @ 4.15c., f. o. b. and upward.

Antimony—Cookson's, 7¼c.; Hallett's, 6¾ @ 7c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 38 @ 41c.

▲ ▲ ▲

Manufactures.

New shops will be added to the plant of Reed & Co., Massillon, O.

The Norwalk Iron Works, Norwalk, Conn., will erect a machine shop.

The Brown mill, of Brownwood, Tex., was recently destroyed by fire.

The Manheim Foundry, at Manheim, Pa., was recently destroyed by fire.

The Sioux City Starch Company, Sioux City, Ia., will enlarge its plant.

H. W. Mathews & Co.'s plant, at Bascom, O., was recently destroyed by fire.

Wellbaum Bros., of Brookville, O., are building a machine shop, 40 x 100 feet.

Foster & Cullen, of Philadelphia, are making extensive alterations to their plant.

At Marshfield, Minn., Lang & Shaarman will erect a foundry and machine shop.

The Standard Steel Works, at Burnham, Pa., are making additions to their plant.

At Osceola Mills, Pa., fire destroyed the foundry and machine shop of S. B. Stine.

The Boston store of Jenkins Bros. has been removed to No. 17 Pearl street, that city.

The York Soap Works, of York, Pa., are to enlarge the plant and add new machinery.

The Woolley foundry and machine works, Anderson, Ill., were lately destroyed by fire.

The Marrow Machine Company, of Hartford, Conn., will build a new factory 40 x 100 feet.

At Alton, Ill., the Duncan Foundry Company has begun the construction of an addition.

At Bronson, Mich., Mr. H. M. Stowe is interested in the erection of a cement plant there.

The Syracuse (N. Y.) Specialty Manufacturing Company has gone into the hands of a receiver.

The Worcester & Marlboro Street Railway Company will erect a power house in Northboro, Mass.

The foundry and machine shops of the Dolan Company, at Logansport, Ind., were recently burned.

The Michigan Pipe Works, at Bay City, Mich., which were recently destroyed by fire, are to be rebuilt.

(*Continued on page 41.*)

The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

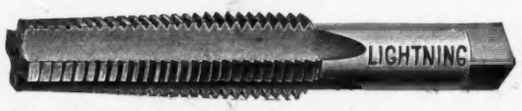
...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—BUCK & HICKMAN, 280 Whitechapel Road, London, E.
France—FENWICK FRERES & Co., 21 Rue Martel, Paris.
Germany and Austria—SCHUCHARDT & SCHUTTE, Berlin and Vienna.
Chicago—42 and 44 South Clinton St. *Boston*—281 Franklin St. *New York*—123 Liberty St.

FINE MACHINE RELIEVED TAPS OF EVERY DESCRIPTION.



"Lightning" and "Green River" Brands of Screw Plates, Dies, Reamers, Tap Wrenches, Bolt Cutters, Drilling Machines, etc.

SEND FOR CATALOGUE.

WILEY & RUSSELL MFG. Co., Greenfield, Mass., U. S. A.
Agents in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

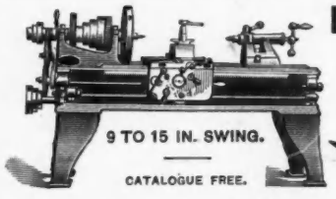
SECOND EDITION.

KENT'S MECHANICAL ENGINEERS' POCKET BOOK.

1,064 Pages, 12mo, Cloth, $5.00.

"A Great Work Well Done."—R. H. Thurston.

JOHN WILEY & SONS, - - - - - NEW YORK.



Lathes! Planers!! Shapers, &c.!!!

Our tools are all of the latest and most approved designs, while the workmanship, material and finish are of the highest order. You will find it an advantage to have our catalogue and special prices before placing your order.

SEBASTIAN LATHE CO.,
117 and 119 CULVERT ST., CINCINNATI, OHIO.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N.Y.

Have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.
Thomas A. Edison

STAR LATHES

★★★

Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
697 Water St., Seneca Falls, N.Y.

WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.

1. Manufacturered of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.

JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston.

NORTON EMERY WHEEL CO. EMERY WHEELS.

ILLUSTRATED CATALOGUE FREE.

WORCESTER MASS.

EVANS FRICTION CONE PULLEYS

Hanging and Standing CONES.

MADE IN ALL SIZES.

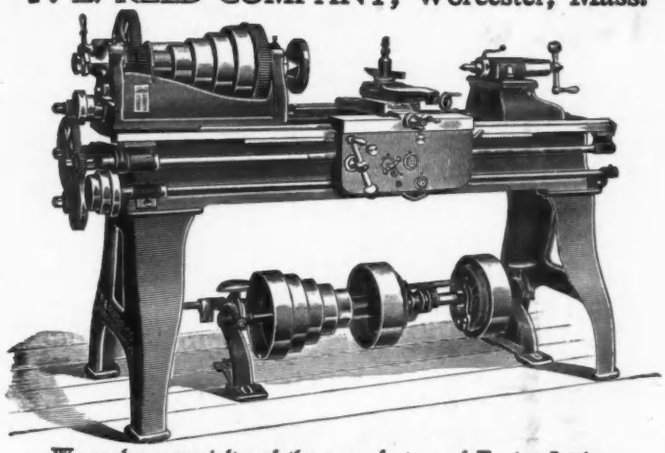
Thousands in use transmitting from 1 to 40 H. P.

For information address, G. F. EVANS, Proprietor,

No. 85 Water St., Boston, Mass.

C. W. BURTON, GRIFFITHS & CO., Agents, London, Eng.

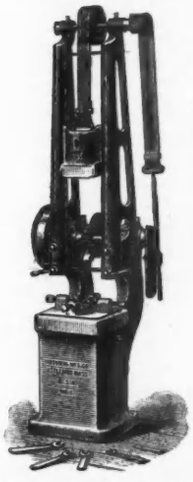
F. E. REED COMPANY, Worcester, Mass.



We make a specialty of the manufacture of Engine Lathes.

AGENTS, { MANNING, MAXWELL & MOORE, New York, Pittsburgh and Chicago.
CHAS. CHURCHILL & CO., Ltd., 9 Leonard Street, Finsbury, London, E. C., England.
FENWICK FRERES & CO., 21 Rue Martel, Paris, France.
GUSTAV DIECHMANN & SOHN, Zimmerstrasse 87, Berlin, S. W. 12, Germany.
G. KOEPPEN & CO., Moscow Russia.

MOSSBERG & GRANVILLE MFG. CO.



No. 1 Auto. Drop Press.

HEADQUARTERS FOR

Modern DROP, PUNCHING, DRAWING, BROACHING FOOT AND SCREW

PRESSES

ESTIMATES GIVEN ON ALL CLASSES OF

...Die Work...

PROVIDENCE, R. I.

It is especially designed for long terms of service under most exacting conditions, where it will ever be found worthy of your confidence—we allude to THE EXCELSIOR VALVE. It does cost a little more than common Valves, but not so often, and it exerts a "back pressure" on your expense account long enough to convince you of its true "cheapness." Would you like a little Catalogue of its "whys and wherefores"? It may be had for the asking.

THE KELLY & JONES CO.,
104 John Street, New York.

(*Continued from page 40.*)

The Warren Manufacturing Company, of Aiken, S. C., contemplates the erection of a new mill at that place.

The extensive plant of the Lebanon Boiler Foundry & Machine Company, Lebanon, Pa., was gutted by fire lately.

The extensive plant of the Scranton Heat & Power Company, Scranton, Pa., was destroyed recently by fire.

The Coburn Trolley Track Company will move from Holyoke to Willimansett, Mass., and erect new buildings.

At Bridgewater, Mass., Charles Perkins and Henry J. Nutter intend to go into the manufacturing of light machinery.

The factory of C. C. Funner & Co., manufacturers of metallic binding at Farnesville, O., has been destroyed by fire.

Extensive improvements are being made at the works of the Consolidated Steel Wire & Nail Company, Beaver Falls, Pa.

The Hamilton (O.) Machine & Foundry Company will erect a brick building one story high and 119 x 40 feet in length.

The Stewart Manufacturing Company, of West Newton, Pa., has a large force of men at work erecting a new building.

The George F. Blake Manufacturing Company, of Cambridgeport, Mass., intends to erect a large addition to its plant.

It is reported that the Weldess Tube & Steel Works will be built at Newark, O., providing $15,000 more stock is taken.

At Fostoria, O., a new factory may be erected by B. G. Tremaine, of Cleveland, and others, to manufacture electric lamps, etc.

Weilbaum Bros., of Brookville, O., are building a machine shop, 40 x 100 feet, two stories high, with power plant, 60 to 80 horse-power.

The Keystone Manufacturing Company, of Sterling, Ill., manufacturers of farming implements, has been placed in the hands of a receiver.

The Greensburg, Jeanette & Pittsburg Electric Railway is contemplating the erection of an electric power house at Oxford Park, near Jeanette, Pa.

The manufacturing plant of the J. H. McEwen Manufacturing Company, at Ridgway, Pa., is advertised to be sold at public auction February 22d.

The National Car Brake Company has been formed at Memphis, Tenn. A. S. Caldwell, J. C. Neeley, Bolton Smith and T. C. Looney are interested.

The plant of the Missouri Frog & Crossing Company, at Centropolis, Mo., was recently destroyed by fire. The plant will be rebuilt at once.

The Davis & Egan Machine Tool Company have received an order for a complete machine shop equipment from Swingerly & Co., Johannesburg, South Africa.

Edward E. Ayers, of Chicago, Ill., has arranged for the erection of a large creosote plant at Somerville, Tex. It is said that the plant will cost $150,000.

The Vaughn Machine Company, at present doing business in Peabody, Mass., may remove to Salem, Mass., and it is likely that a new shop may be erected.

The Meehan Boiler Company are intending to convert the buildings of the Lowellville Lumber Company, Lowellville, O., into a foundry, machine shops, etc.

MODERN MACHINE TOOLS.

BETTS MACHINE COMPANY,
WILMINGTON, DEL., U. S. A.

This is our No. 5 Grinder in miniature. It shows the general design of our goods. Notice the engine lathe boxes. What do you want in the line of grinding machinery?

DIAMOND MACHINE CO., Providence, R.I., Chicago, Ill.

London, CHAS. CHURCHILL & CO., Ltd.
Paris, FENWICK FRERES.
Berlin, SCHUCHARDT & SCHUTTE.
Copenhagen, V. LOWENER.

UPRIGHT DRILLS A SPECIALTY

20 in. plain, 20 in. p. f. a. s., 21 in. b. g. p. f. a. s., 25 in. b. g. p. f. a. s. Stationary Head, and 24 in., 25 in., 28 in., 30 in., 34 in. and 36 in. b.g.p.f. a.s. Sliding Head. *Best all-around Drills in America.*

J. E. SNYDER, Worcester, Mass., U.S.A.

London Agents, C.W. Burton, Griffiths & Co.
Copenhagen Agent, V. Lowener.
Berlin Agent, Herr Hans Richter.
G. Koeppen & Co., Moscow, Russia.

The Vitrified Wheel Co.

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• • •

Emery and Corundum Wheels

For all Grinding Purposes, with and without Wire Web. The kind that cut and wear. . . . . .

London Agents:—CHARLES NEAT & CO.

Machinists' Fine Tools
STANDARD TOOL CO., ATHOL, MASS
SEND FOR NEW CATALOGUE

CH. BESLY & CO. CHICAGO ILL. U.S.A.
BONANZA CUP
USE HELMET OIL IN THIS
BONANZA
OIL CUP
SEND FOR CATALOGUE.
CHARLES H. BESLY & Co
METAL WORKERS FINE TOOLS & SUPPLIES
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CHICAGO ILL. U.S.A.

Machinists

FITTERS, TURNERS, PLANERS, ETC.

French, Belgian or Flemish workmen, first-class only, returning to the Continent, can be offered permanent situations at the

SOCIETE ANONYME DU PHŒNIX, Ghent, Belgium.

Those accustomed to the manufacture of Machine Tools preferred. Apply or address by letter as above.

We Claim that it will do more work than any similar tool in the market. No danger of breaking tools.

Never back live spindle.

THE UNION TIRE CO.
PLAINFIELD, N. J.

MAKERS OF

THE FULMER Drilling and Tapping Attachment.

Drills and taps holes either through or bottom, without reversing or stopping machine.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

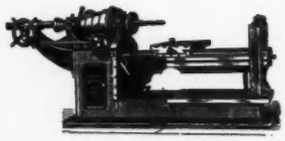
See our SPECIAL OFFER OF

SQUARES

In the Jan. 7th issue of this paper

SAWYER TOOL COMPANY,
ATHOL, MASS.

DRILLS



HOR. BOR. AND DRILL. MACH.

FITCHBURG MACHINE WORKS,

FITCHBURG, MASS., U.S.A.

METAL WORKING MACHINERY

CATALOG E.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

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WM. B. FRANKLIN, Vice-President.
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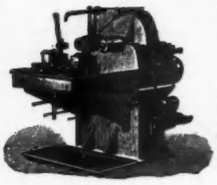

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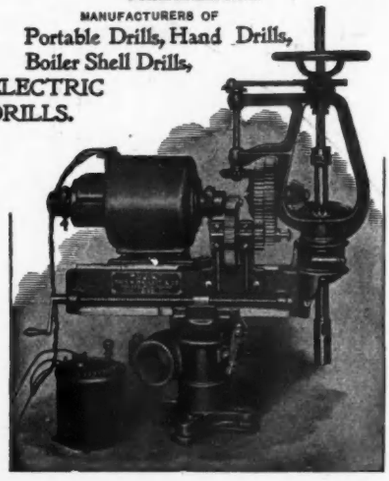

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